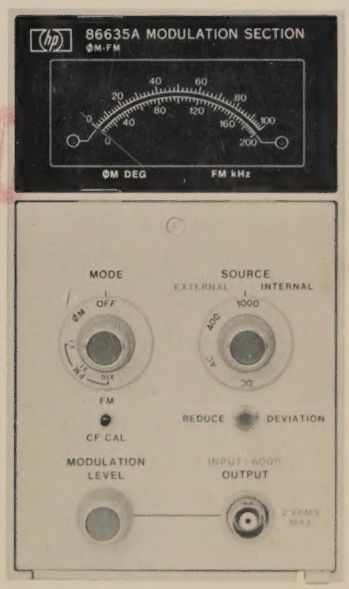
HP 86635A

OPERATING AND SERVICE MANUAL

M2035-7X

86635A
MODULATION SECTION
ØM-FM



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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in the manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

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OPERATING AND SERVICE MANUAL

86635A
MODULATION SECTION ØM-FM

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1707A.

With the changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1417A, 1535A, 1605A and 1638A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

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CONTENTS

Section		Page
I	GENERAL INFORMATION	1-1
1-1.	Introduction	1-1
1-7.	Specifications	1-1
1-9.	Instruments Covered by Manual	1-1
1-12.	Manual Change Supplement	1-1
1-15.	Description	1-2
1-21.	Incompatibility	1-2
1-23.	Equipment Required But Not Supplied	1-2
1-24.	Mainframes	1-2
1-26.	RF Sections and Frequency Extension Modules	1-2
1-28.	Equipment Available	1-2
1-29.	Accessories	1-2
1-31.	Service Kit	1-2
1-33.	Safety Considerations	1-2
1-37.	Recommended Test Equipment	1-4
II	INSTALLATION	2-1
2-1.	Introduction	2-1
2-3.	Initial Inspection	2-1
2-5.	Preparation for Use	2-1
2-6.	Meter Zeroing	2-1
2-8.	Power Requirements	2-1
2-10.	Operating Environment	2-1
2-14.	Interconnections	2-1
2-16.	Modifications	2-1
2-18.	Storage and Shipment	2-2
2-19.	Environment	2-2
2-21.	Packaging	2-1
III	OPERATION	3-1
3-1.	Introduction	3-1
3-4.	Panel Features	3-1
3-6.	Operator's Check	3-1
3-8.	Operating Instructions	3-1
3-9.	Local and Remote Modes	3-1
3-14.	Ensuring Calibrated Modulation Level	3-1
3-19.	Deviation Direction	3-1
3-21.	Operator's Maintenance (Lamp Replacement)	3-2
IV	PERFORMANCE TESTS	4-1
4-1.	Introduction	4-1
4-3.	Equipment Required	4-1
4-5.	Test Record	4-1
4-7.	Internal Modulation Rates and Output Level	4-1
4-8.	FM Deviation and Meter Accuracy	4-2
4-9.	Modulation Distortion	4-3
4-10.	FM Input Level and Rate	4-4
4-11.	Phase Modulation Input Level and Rate	4-5
4-12.	Remote Programming	4-7
V	ADJUSTMENTS	5-1
5-1.	Introduction	5-1
5-3.	Recommended Test Equipment	5-1
5-7.	Factory Selected Components	5-1
5-9.	Related Adjustments	5-1
5-11.	Adjustment Locations	5-1
5-13.	Safety Considerations	5-2
5-19.	Post-Repair Test and Adjustments	5-2
5-22.	Modulation Oscillator Adjustment	5-2
5-23.	Amplitude Leveling Adjustment	5-3
5-24.	Remote Modulation Signal Level and Meter Adjustments	5-4
5-24a.	Alternate Meter Adjustment Procedure if Remote Programming is not Used	5-5
5-25.	Reduce Deviation Lamp Adjustment	5-6
5-26.	FM Deviation Attenuator Adjustment	5-7
5-27.	VCO Center Frequency Adjustment	5-8
VI	REPLACEABLE PARTS	6-1
6-1.	Introduction	6-1
6-3.	Abbreviations	6-1
6-5.	Replaceable Parts List	6-1
6-7.	Ordering Information	6-1
6-10.	Spare Parts Kit	6-1
6-12.	Direct Mail Order System	6-1
VII	MANUAL CHANGES	7-1
7-1.	Introduction	7-1
7-3.	Manual Changes	7-1
7-6.	Manual Change Instructions	7-1
VIII	SERVICE	8-1
8-1.	Introduction	8-1
8-8.	Safety Considerations	8-1
8-12.	Principles of Operation	8-1
8-15.	Troubleshooting	8-1
8-16.	System Troubleshooting	8-2
8-18.	Modulation Section Troubleshooting	8-2
8-20.	Troubleshooting Aids	8-2
8-27.	Recommended Test Equipment	8-2
8-29.	Repair	8-2
8-30.	General Disassembly Procedures	8-2
8-33.	Post Repair Adjustments	8-2
8-35.	Principles of Systems Operation	8-2
8-37.	RF Signal Flow	8-6
8-39.	Remote Operation	8-6
8-41.	Local Operation	8-6

ILLUSTRATIONS

Figure Page

1-1. HP Model 86635A Modulation Section 1-0

2-1. Model 86635A Being Installed in Mainframe. . . . 2-2

3-1. Front and Rear Panel Controls, Connectors, and Indicators. 3-4
3-2. Operator's Check. 3-5
3-3. Phase Modulation (ϕM) Spectrum 3-6
3-4. Frequency Modulation (FM) Spectrum 3-6
3-5. Front Panel Operating Instructions 3-7

4-1. Internal Modulation Rate and Output Level Test Setup 4-1
4-2. FM Deviation and Meter Accuracy Test Setup. . . 4-2
4-3. FM Input Level and Rate Test Setup. 4-4
4-4. Phase Modulation Input Level and Rate Test Setup 4-6
4-5. 82° Phase Modulation 4-7
4-6. 138° Phase Modulation. 4-7
4-7. Remote Programming Test Setup 4-8

5-1. Modulation Oscillator Adjustment Test Setup. . . 5-2
5-2. Amplitude Leveling Adjustment Test Setup 5-3
5-3. Remote Modulation Signal Level and Meter Adjustment Test Setup. 5-4
5-4. Reduce Deviation Lamp Adjustment Test Setup 5-6
5-5. FM Deviation Attenutor Adjustment Test Setup 5-7
5-6. VCO Center Frequency Adjustment Test Setup 5-9

8-1. Schematic Diagram Notes 8-3
8-2. Circuit Board Extended for Troubleshooting . . . 8-5
8-3. System Block Diagram 8-7
8-4. Troubleshooting Block Diagram 8-13
8-5. Simplified Switch Logic Block Diagram 8-15

Figure Page

8-6. A2 Switch Logic Assembly Component Locations 8-15
8-7. A2 Switch Logic Assembly Schematic Diagram 8-15
8-8. A5 Modulation Oscillator Assembly Component Locations 8-17
8-9. A5 Modulation Oscillator Assembly Schematic Diagram 8-17
8-10. A4 Leveling Amplifier Assembly Component Locations 8-19
8-11. A4 Leveling Amplifier Assembly Schematic Diagram 8-19
8-12. Voltage Comparator. 8-20
8-13. A3 Remote Attenuation Assembly Component Locations 8-21
8-14. A3 Remote Attenuation Assembly Schematic Diagram 8-21
8-15. FM Center Frequency Calibration Time Sequence 8-22
8-16. A6 FM Attenuator Assembly Component Locations 8-23
8-17. A6 FM Attenuator Assembly Schematic Diagram 8-23
8-18. A7A1 20 MHz Mixer and A7A2 Switch Assembly Component Locations 8-25
8-19. A7A3 20 MHz VCO Assembly Component Locations 8-25
8-20. Rear Panel (A7A1, 2, and 3) Assembly Schematic Diagram 8-25
8-21. A9 Deviation Detector Assembly Component Locations 8-27
8-22. A9 Deviation Detector Assembly Schematic Diagram 8-27
8-23. Mainframe Interconnect Jack. 8-28
8-24. A8 Mother Board Assembly Component Locations 8-28
8-25. Assembly, Chassis Mounted Parts, Adjustable Components, and Test Point Locations 8-29

TABLES

Table Page

1-1. Specifications 1-3
1-2. Recommended Test Equipment 1-4

3-1. BCD Programming. 3-2
3-2. HP-IB Programming 3-2
3-3. Frequency Deviations for Remote Programmed Modulation Levels 3-3

4-1. Performance Test Record 4-9

5-1. Factory Selected Components 5-1

Table Page

6-1. Reference Designations and Abbreviations 6-2
6-2. Replaceable Parts 6-4
6-3. Code List of Manufacturers. 6-15

7-1. Manual Changes by Serial Number 7-1

8-1. Assembly Information Index. 8-12
8-2. Truth Table for MODE Functions. 8-14
8-3. Truth Table for SOURCE Functions. 8-14
8-4. Assembly, Chassis Mounted Parts, and Adjustable Component Locations. 8-29

SAFETY CONSIDERATIONS

GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND

This instrument is used with a Safety Class I product (provided with a protective earthing terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER

Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an auto-transformer make sure the common terminal is connected to the neutral (grounded side of mains supply).

SERVICING

WARNINGS

Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement in the mainframe.

MODEL 86635A

Figure 1-1. HP Model 86635A Modulation Section

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust, and service the HP Model 86635A Modulation Section plug-in.

1-3. The various sections of this manual provide information as follows:

a. SECTION I, GENERAL INFORMATION, such as description, specifications, accessories, and recommended test equipment.

b. SECTION II, INSTALLATION, provides information relative to incoming inspection, preparation for use, mounting, packing and shipping.

c. SECTION III, OPERATION, provides information relative to operating the instrument.

d. SECTION IV, PERFORMANCE TESTS, provides information required to ascertain that the instrument is performing in accordance with published specifications.

e. SECTION V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs.

f. SECTION VI, REPLACEABLE PARTS, provides ordering information for all parts and assemblies.

g. SECTION VII, MANUAL CHANGES, contains backdating information to make documentation in this manual applicable to all earlier versions of this instrument.

h. SECTION VIII, SERVICE, includes information required to service the instrument.

1-4. Figure 1-1 shows the Modulation Section.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 100 x 150 mm (4 x 6-inch) microfilm transparencies of the manual. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed on Table 1-1. These specifications are the preformance standards, or limits against which the instrument may be tested.

1-9. INSTRUMENTS COVERED BY MANUAL

1-10. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix as listed under SERIAL NUMBERS on the title page.

1-11. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-12. MANUAL CHANGE SUPPLEMENT

1-13. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-14. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supple-

MANUAL CHANGE SUPPLEMENT (Cont'd)
ment for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-15. DESCRIPTION

1-16. The HP Model 86635A Modulation Section is one of several plug-in units available for use in a Model 8660-Series Synthesized Signal Generator System. This model features both phase and frequency modulation.

1-17. An internal oscillator provides modulation drive rates of 400 and 1000 Hz. The oscillator output is available at the front panel jack for test purposes or for a synchronizing trigger for an oscilloscope. External modulation signal sources are connected to the front panel jack and may be either ac coupled or dc coupled.

1-18. The phase modulation range is from 0° to 100° below 1300 MHz and 0° to 200° at and above 1300 MHz. Phase modulation is indicated on the front panel in degrees from 0° to 200°. For phase modulation the Modulation Section supplies a modulating signal to the RF Section. Phase modulation then takes place in the RF Section.

1-19. Frequency modulation peak deviation is from 0 to 1 MHz below 1300 MHz and 0 to 2 MHz at or above 1300 MHz. Frequency modulation peak deviation is indicated on the front panel meter in kilohertz. Frequency modulation takes place in the Modulation Section and is then coupled to the Frequency Extension Module.

1-20. Programmed inputs (remote mode) may be used to control all the functions of the Modulation Section. Programmed data is routed through the Mainframe to the Modulation Section storage registers. The decoded data selects mode source, and modulation level. The FM CF CAL function may also be programmed.

1-21. INCOMPATIBILITY

1-22. With the exception of certain unmodified mainframes, the Modulation Section is compatible with all instruments which make up the Synthesized Signal Generator System. If the Modulation Section is installed in an unmodified mainframe, the modulation level meter reading will be incorrect in the FM mode at center frequencies $\geq$1300 MHz. Refer to the paragraph entitled Modifications in Section II.

1-23. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-24. Mainframes

1-25. The HP Model 8660-Series mainframe provides the power, control logic, and RF signal inputs needed to operate the Modulation Section, RF Section, and Frequency Extension Module plug-ins. The mainframe also serves to interconnect the plug-ins.

1-26. RF Sections and Frequency Extension Modules

1-27. The Model 86600-series RF Section and the 11661-series Frequency Extension Module mix the RF inputs from the mainframe and Modulation Section to produce the system center frequency. Systems with maximum center frequency less than or equal to 160 MHz do not use a Frequency Extension Module. A suitable RF Section (with Option 002) is required for phase modulation.

1-28. EQUIPMENT AVAILABLE

1-29. Accessories

1-30. Extender cards for use in servicing the 8660 system are supplied with the mainframe. A complete listing of the contents is found in Section I of the mainframe manual.

1-31. Service Kit

1-32. The HP 11672A Service Kit contains interconnector cables, RF cables, various coaxial adapters, and an adjustment tool, all of which are useful in servicing the mainframe and plug-in units. Refer to HP 11672A Operating Note or the 8660-series mainframe manual for a listing and details of the contents.

1-33. SAFETY CONSIDERATIONS

1-34. The Modulation Section has been manufactured and tested in accordance with HP standards.

1-35. Documentation for the Modulation Section and other sections of the Synthesized Signal Generator System should be received before operating or servicing. Anyone who operates or services the system should be familiar with safety markings and instructions. Refer to the Safety Considerations

Table 1-1. Specifications

SPECIFICATIONS

Functions: Internal and external ϕM or FM. Both modes are fully programmable.

Meter: ϕM range 0 to 100° peak for frequencies below 1300 MHz and 0 to 200° ⩾1300 MHz.

FM Range Deviation: 0 to 10 kHz, 100 kHz, or 1 MHz for frequencies below 1300 MHz and 0 to 20 kHz, 0 to 200 kHz, or 0 to 2 MHz ⩾1300 MHz.

Reduce Deviation Indicator: Lights when deviation exceeds limits (approximately 110% of full scale).

FM CF CAL: In the FM mode, depressing the front panel FM CF CAL button initiates a 5-second internal calibration cycle to correct any VCO drift. This feature is also programmable.

Internal Modulation

Internal Rates: 400 Hz and 1 kHz ±5%.

ϕM:

Deviation: Continuously adjustable from 0 to 100° below 1300 MHz or 0 to 200° ⩾1300 MHz.

FM:

Deviation: Adjustable from 0 to 1 MHz peak or maximum specified for RF Section installed.

Distortion: Maintains minimum ϕM/FM distortion specified for RF Section used.

Modulating Signal Output: Selected internal modulation signal provided at front panel BNC connector at level of 200 mVrms minimum into 10 kΩ resistive load.

External Modulation

Input Level Required:

AC Mode: External modulating signal must be between 1 and 2 Vrms to provide proper leveling amplifier performance.

DC Mode: External modulating signal must be approximately 1.8 Vrms (2.0 Vrms maximum) to maintain full vernier range and calibrated remote programming of modulation.

Input Impedance: 600 ohms.

ϕM:

Rate: DC to 1 MHz in DC mode, or 20 Hz to 1 MHz in AC mode. Not to exceed 1/10 of carrier frequency. Maximum usable modulation rate depends on specifications for RF Section installed.

Deviation: 0 to 100° maximum for center frequencies below 1300 MHz; 0 to 200° for center frequencies ⩾1300 MHz. Maximum usable deviation depends on specifications for RF Section installed.

Distortion: External modulating signal distortion must be less than 0.3% to meet RF Section specifications.

***Indicated ϕM Accuracy:** ±5% of full scale up to 100 kHz rates at 25°C; ±8% of full scale up to 1 MHz rates at 25°C.

FM:

Rate: DC to 1 MHz in DC mode, or 20 Hz to 1 MHz in AC mode. Not to exceed 1/10 of carrier frequency. Maximum usable modulation rate depends on specifications for RF Section installed.

Deviation: 0 to 1 MHz peak for center frequencies below 1300 MHz: 0 to 2 MHz for center frequencies ⩾1300 MHz. Maximum usable deviation depends on specifications for RF Section installed. Cannot exceed 1/10 of carrier frequency.

Distortion: External modulation signal distortion must be less than 0.3% to meet RF Section specifications.

Indicated FM Accuracy: ±5% of full scale up to 20 kHz rates.

Remote Programming

Modulation Setting Resolution: 1/50 of the 100 range and 1/100 of the 200 range for either ϕM or FM.

Modulation Setting Accuracy: 5% of setting or 1/2% of full scale whichever is greater for FM. ±5% of full scale up to 100 kHz rates at 25°C; ±8% of full scale up to 1 MHz rates at 25°C for ϕM.

General

Size: Plug-in to fit all 8660 mainframes.

Weight: Net, 2.6 kg (6 lb).

*Typical temperature coefficient is 0.1%/°C around 25°C.

SAFETY CONSIDERATIONS (Cont'd)

page found at the beginning of the manuals for a summary of safety information.

1-36. Safety information pertinent to the task at hand (installation, operation, performance testing, adjustments or service) is found throughout this manual.

1-37. RECOMMENDED TEST EQUIPMENT

1-38. Table 1-2 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the Modulation Section. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

Table 1-2. Recommended Test Equipment

Item	Minimum Specifications	Suggested Model	Use*
Analyzer, Spectrum	Measurement Accuracy ±2.0 dB from 10 MHz to to 2600 MHz. Resolution bandwidth 0.3 to 100 kHz.	HP 140T with HP 8555A and HP 8552B plug-ins	P, S
Analyzer, Wave	1 to 2 kHz 200 Hz maximum bandwidth	HP 310A	P
Attenuator	3 dB pad	HP 8491A, Option 003	A, S
Cable, Extender	Part of HP 11672A Service Kit	HP 11672-60002	A
Counter, Frequency	Range 200 Hz to 30 MHz	HP 5340A	P, A, S
FM Discriminator	100 kHz to 1 MHz with 1V sensitivity	HP 5210A, Option 010	P, A
Oscillator, Test	10 Hz to 1 MHz; 1.0 to 2.0 Vrms into 600 ohms	HP 651B	P, A, S
Oscilloscope	DC to 1 MHz, delayed sweep, time base 50 ns to 1s	HP 180C with HP 1801A and HP 1821A plug-ins	P, A, S
Oscilloscope Divider Probe, 10:1	10:1 divider 10 Megohm 10 pF	HP 10004A	P, A, S
Programmer, Marked Card	Capable of programming BCD or HP-IB data	HP 3260A, Option 001	P
Resistor, 10K	±2%	HP 0757-0442	P, S
Tee, Coaxial		HP 1250-0781 (BNC)	P
Voltmeter, Digital	Accuracy: ±0.2% Range:. 0.00 to ±30 Vdc	HP 34740A with HP 34702A plug-in	S
Voltmeter, True RMS	±0.1 dB from 100 Hz to 1 MHz 1 mVrms to 1 Vrms	HP 3403C	A, S

*A = Adjustment Procedure, P = Performance Test, S = Service and Troubleshooting

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information relative to initial inspection, preparation for use, and storage and shipment of the Modulation Section plug-in. Initial inspection provides instructions to be followed when an instrument is received in a damaged condition. Preparation For Use gives all necessary interconnection and installation instruction. Storage and Shipment provides instructions and environmental limitations pertaining to instrument storage; also provided are packing and packaging instructions which should be followed in preparing the instrument for shipment.

2-3. INITIAL INSPECTION

2-4. This instrument met all of its performance specifications when packaged for shipment. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for the carrier's inspection.

2-5. PREPARATION FOR USE

2-6. Meter Zeroing

2-7. With the power off, the Modulation Section meter indicator needle should be positioned on zero. If the needle is not on zero, turn the zero set screw adjustment counterclockwise to bring the needle below zero. Slowly rotate the zero set clockwise until the indicator is on zero. Rotate the zero set about 30 degrees counterclockwise.

2-8. Power Requirements

2-9. The power required for operation of the Modulation Section is furnished by the mainframe. Power consumption of the Modulation Section is approximately 5 volt-amperes.

2-10. Operating Environment

2-11. Temperature. Cooling is provided to the Modulation Section by a fan in the mainframe. This assures the internal temperature of the instrument stays within reasonable limits when the instrument is operated at ambient temperature between 0 and 55°C (32 to 131°F).

2-12. Humidity. The instrument may be operated in environments with humidity up to 95%. However, the instrument should also be protected from temperature extremes which may cause condensation within the instrument.

2-13. Altitude. The instrument may be operated at altitudes up to 4500 m (15 000 feet).

WARNING

The multiple pin connector at the rear of the plug-in cavity in the mainframe will be exposed when the Modulation Section is removed. Avoid contact with these exposed pins even with the line (mains) voltage off and the power cord disconnected. Power supply voltages may still remain which, if contacted, may result in personal injury.

2-14. Interconnections

2-15. With the 8660 line power turned off, insert the Modulation Section into the left plug-in cavity in the mainframe and push it about half way in. The latch, at the lower right corner of the front panel, should be rotated to the left until it protrudes perpendicular to the front panel. Push the plug-in all the way in and rotate the latch to the right until it snaps into place. Refer to Figure 2-1.

2-16. Modifications

2-17. The frequency doubler function modification must be installed to ensure correct frequency modulation level readings at all center frequencies.

Modifications (Cont'd)
Model 8660A and 8660B mainframes with serial prefix 1503A and below must have a field update kit installed. For mainframe configurations other than Option 005 (BCD programming format), order kit number 08660-60306. For Option 005 mainframes (HP-IB format), order kit number 08660-60308.

2-18. STORAGE AND SHIPMENT

2-19. Environment

2-20. The storage and shipping environment of the Modulation Section should not exceed the following limits:

Temperature . . . . . .—40° C to +75° C
Humidity. . . . . Up to 95%
Altitude. . . . . Up to 7600 m (25 000 feet).

The instrument should also be protected from temperature extremes which may cause condensation within the instrument.

2-21. Packaging

2-22. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-23. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.

b. Use a strong shipping container. A double-wall carton made of 250-pound test material is adequate.

c. Use enough shock-absorbing material, 75 to 100 mm (3 to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

Figure 2-1. Model 86635A Being Installed in Mainframe

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section provides operating instructions for the Hewlett-Packard Model 86635A Modulation Section.

3-3. The Modulation Section is designed to control the ϕM, FM, or CW output of the RF Section.

3-4. PANEL FEATURES

3-5. Front and rear panel controls, indicators, and connectors of the Modulation Section are shown in Figure 3-1.

3-6. OPERATOR'S CHECK

3-7. An operator's check which gives reasonable assurance that the instrument is capable of normal performance is shown in Figure 3-2.

3-8. OPERATING INSTRUCTIONS

3-9. Local and Remote Modes

3-10. The Modulation Section may be operated by front panel controls in the local mode or externally programmed in the remote mode.

3-11. Local (Front Panel) Operation. Figure 3-4 provides local mode operating instructions for the Modulation Section.

3-12. Remote (Programmed) Operation. Application Note 164-1, "Programming the 8660A/B Synthesized Signal Generator" provides most of the information needed for remote operation using the BCD interface. AN-164-2 "Calculator Control of the 8660A/B/C Synthesized Signal Generator" provides programming information for the Hewlett-Packard Interface Bus (HP-IB). Information pertaining to remote operation is also included in abridged form in Section III of the Mainframe manuals.

3-13. Additional operating information is found in the appropriate manual. For example, in this manual, BCD and HP-IB programming codes for the Model 86635A are found in Tables 3-1 and 3-2. Table 3-3 contains examples of programmed modulation level and the actual modulation level at center frequencies above and below 1300 MHz.

3-14. Ensuring Calibrated Modulation Level

3-15. The information in the following paragraphs may be used to ensure calibrated modulation level readings under different operating modes and conditions.

3-16. Source Control Settings and External Inputs. The Modulation Section meter indicates the correct modulation level if the SOURCE selected is INTERNAL, or if the input to the front panel jack is 1 to 2 Vrms in the EXTERNAL AC mode, or if the input is 1.80 ± 0.02 Vrms in EXTERNAL DC mode.

3-17. FM DC Inputs. Due to internal signal inversion, the modulation meter circuit in the Modulation Section actually responds to the negative peaks of the input modulating signal. Therefore, for dc inputs, it is necessary to set the modulation level with a negative dc level. The value of this input should be 2.54 ± 0.03 Vdc (1.414 times 1.8 Vrms) which is the equivalent of the peak value of the specified input. Next, the MODULATION LEVEL control should be used to set the desired deviation. The polarity of the dc input may then be reversed and although the meter will indicate zero, the center frequency will be shifted in the opposite direction. After making this setup, programmed inputs are calibrated for dc modulation inputs.

3-18. Meter Driver Frequency Response. The modulation meter circuit responds properly to a dc input (negative) and to rates above 50 Hz. Between these limits the meter detector circuit will produce a low reading. To use the meter circuit properly, set the deviation desired at either dc or at rates above 50 Hz (to 100 Hz) and ignore the meter reading at the low rates.

3-19. Deviation Direction

3-20. In the FM mode, a positive going modulation signal causes the system center frequency to increase.

Table 3-1. BCD Programming

Data		Data Description	Command Function
D_1	D_2		
0001 0010 0100 1000		INT 1 kHz 400 Hz EXT DC AC	Modulation Type: Source
	0000 0001 0010 0100 1100	OFF FM X10 X1 X.1 ϕM	Modulation Type: Mode
1111	0100		
0001 0010 0011 . . . 0000 0001 . . . 1001 0000	0000 0000 0000 . . . 0001 0001 . . . 1001 1010	1 2 3 . . . 10 11 . . . 99 100	Modulation Level: Number of increments of 1/50 full scale deviation (<1300 MHz) and 1/100 full scale (≥1300 MHz). Refer to Table 3-3.
1111	0101		
1111	0110		FM CF CAL

1. Programming modulation level and modulation type requires two words each. Each word consists of two BCD digits. The first word is formed by taking one BCD digit from each column of the upper part of each section of the table. The second word (specified in the last line of each section of the table) consists of a transfer command and function address.
2. FM CF CAL is programmed by inputting the two BCD digits (transfer command and function address) as shown.
3. Example: To program the internal 1 kHz source in the FM X1 range, 76 kHz peak deviation and FM CF CAL, the following words are input:

   0001 0010 INT 1 kHz; FM X1
   1111 0100 TRANSFER COMMAND; SOURCE/MODE ADDRESS
   1000 0011 76 kHz peak deviation (38%)
   1111 0101 TRANSFER COMMAND; MODULATION LEVEL ADDRESS
   1111 0110 TRANSFER COMMAND; FM CF CAL ADDRESS

Table 3-2. HP-IB Programming

Command			Data Description	Command Function
Data		Program Code		
1 2 4 8		$	INT 1 kHz 400 Hz EXT DC AC	Modulation Type: Source
	0 1 2 4 <		OFF FM X10 X1 X.1 ϕM	Modulation Type: Mode
1 2 3 . . . 0 1 2 . . 9 <blank>	0 0 0 . . . 1 1 1 . . 9 .	%	1 2 3 . . . 10 11 12 . . 99 100	Modulation Level: Number of increments of 1/50 full scale deviation (<1300 MHz) and 1/100 full scale (≥1300 MHz). Refer to Table 3-3.
		&		FM CF CAL

1. Programming modulation level and modulation type requires a three character command for each. This command is formed by taking one character from each of the first three columns in each section of the above table.
2. FM CF CAL is programmed by a one character command.
3. Example: To program the internal 1 kHz source in the FM X1 range, 76 kHz peak deviation and FM CF CAL, the following command is sent: 83% 12$&.

3-21. OPERATOR'S MAINTENANCE (LAMP REPLACEMENT)

3-22. The only operator's maintenance is the REDUCE DEVIATION lamp replacement. To replace this bulb, proceed as follows:

a. Unscrew the orange lens covering the REDUCE DEVIATION lamp.

b. Remove the lamp and replace it with a new HP Part No. 2140-0092.

c. Replace the orange lens.

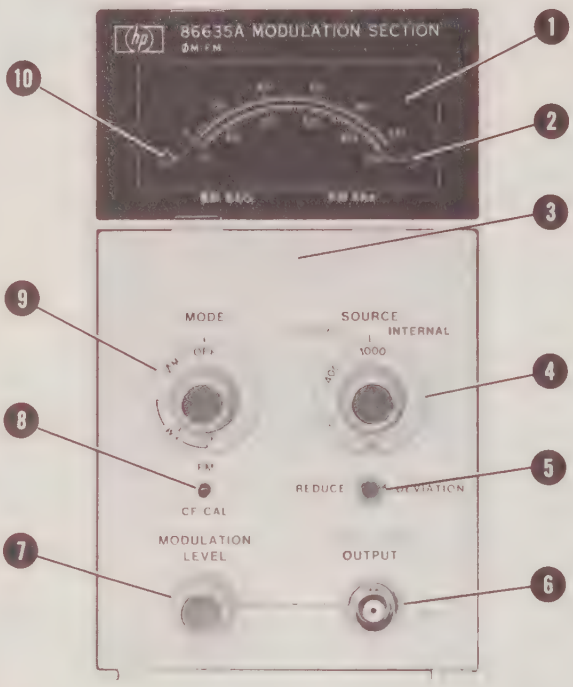
Table 3-3. Frequency Deviations for Remote Programmed Modulation Levels

Programmed Level	ØM		FM x 10		FM x 1		FM x 0.1	
	<1300 MHz	⩾ 1300 MHz	<1300 MHz	⩾1300 MHz	<1300 MHz	⩾1300 MHz	<1300 MHz	⩾1300 MHz
1%	2°	2°	20 kHz	20 kHz	2 kHz	2 kHz	0.2 kHz	0.2 kHz
2%	4°	4°	40 kHz	40 kHz	4 kHz	4 kHz	0.4 kHz	0.4 kHz
3%	6°	6°	60 kHz	60 kHz	6 kHz	6 kHz	0.6 kHz	0.6 kHz
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.
48%	96°	96°	960 kHz	960 kHz	96 kHz	96 kHz	9.6 kHz	9.6 kHz
49%	98°	98°	980 kHz	980 kHz	98 kHz	98 kHz	9.8 kHz	9.8 kHz
50%	100°	100°	1 MHz	1 MHz	100 kHz	100 kHz	10 kHz	10 kHz
51%		102°		1.02 MHz		102 kHz		10.2 kHz
52%		104°		1.04 MHz		104 kHz		10.2 kHz
.		.		.		.		.
55%	*	110°	*	1.10 MHz	*	110 kHz	*	11.0 kHz
.		.		.		.		.
98%		196°		1.96 MHz		196 MHz		19.6 kHz
99%		198°		1.98 MHz		198 MHz		19.8 kHz
100%	*	200°	*	2 MHz	*	200 MHz	*	20 kHz

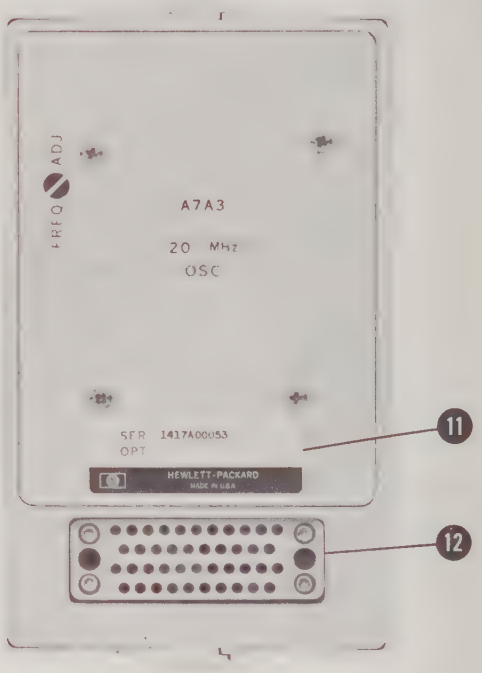
*Overrange, reduce deviation warning light is on.

PANEL FEATURES

FRONT VIEW



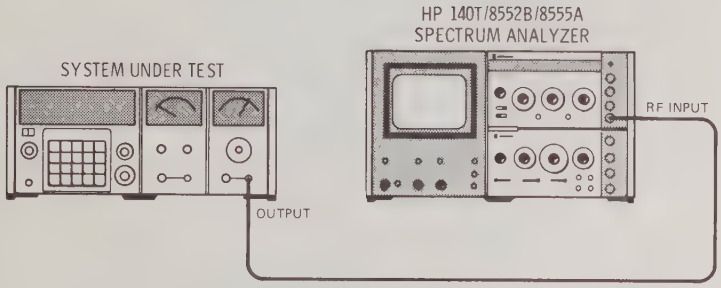
REAR VIEW



1. The modulation level meter indicates ϕM peak deviation in degrees and FM peak deviation in kHz (when multiplied by the FM MODE range).
2. 0—200 scale indicator.
3. The zero set screw is used to zero the modulation level meter needle with no power applied to the Model 8660 system.
4. The SOURCE control selects an INTERNAL 400 or 1000 Hz sine wave oscillator, or AC or DC coupling of an EXTERNAL signal that is connected to the front panel INPUT 600Ω jack.
5. REDUCE DEVIATION lamp indicates when deviation is more than 110% of full scale.
6. The INPUT/OUTPUT connector provides 400/1000 Hz output when the SOURCE control is set INTERNAL, and provides modulating signal input connection in EXTERNAL.
7. The MODULATION LEVEL control sets deviation in local mode.
8. FM CF CAL button operates only in the FM MODE. It activates a 5 second calibration cycle that resets the VCO frequency to 20 MHz and the RF Section output frequency to the center frequency indicated by the Model 8660 Mainframe. FM modulation is discontinued during the calibration cycle.
9. The MODE switch selects OFF (CW), ϕM (phase modulation), or FM (frequency modulation) output from the RF Section.
10. 0—100 scale indicator.
11. Serial Number Plate: the first four digits and letter of a serial number comprise the prefix; the last five digits form the sequential suffix that is unique to each instrument.
12. The plug-in connector to the mainframe provides power inputs and output control signals to the RF Section.

Figure 3-1. Front and Rear Panel Controls, Connectors and Indicators

OPERATOR'S CHECK



WARNING

BEFORE CONNECTING THIS SYSTEM TO LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

NOTE

If the Modulation Section is installed in early model 8660A or 8660B mainframes, the modulation level meter reading will be incorrect at center frequencies ⩾1300 MHz. Refer to the paragraph entitled Modifications in Section II.

a. Connect equipment as shown above.

b. Set the Spectrum Analyzer controls as follows:

Center Frequency	100 MHz
Resolution Bandwidth	0.3 kHz
Frequency Span per Division	2 kHz
Input Attenuation	50 dB
Sweep Time per Division	50 ms
Reference Level	+10 dBm
Vertical Sensitivity per Division	10 dB

c. Set CENTER FREQUENCY on mainframe to 100 MHz.

d. Set the RF Section output level to 0 dBm.

e. Set Modulation Section SOURCE switch to INTERNAL 1000 and MODE switch to OFF (CW).

f. Verify the presence of the 100 MHz CW signal.

g. Change the Modulation Section MODE control to ϕM and adjust the MODULATION LEVEL control for an indication of 82° on the meter. Verify that the carrier and first sidebands are approximately equal as shown in Figure 3-3.

Figure 3-2. Operator's Check (1 of 2)

OPERATOR'S CHECK

h. Change the Spectrum Analyzer controls as follows:

Resolution Bandwidth	100 kHz
Frequency Span per Division	0.1 MHz
Reference Level	−10 dBm
Vertical Sensitivity per Division	10 dB

i. Change the Modulation Section MODE switch to FM X10, SOURCE switch to INTERNAL 400, and adjust the MODULATION LEVEL control to 200 kHz peak deviation (meter reading of 20).

j. Verify that the display is similar to Figure 3-4.

k. Change the Modulation MODE switch to FM X1 and set the MODULATION LEVEL control for a meter reading of 100 (100 kHz peak deviation.)

l. Change the Spectrum Analyzer controls as follows:

Resolution Bandwidth	10 kHz
Frequency Span per Division	0.05 MHz

m. Verify that the display is similar to Figure 3-4.

n. Change the Modulation Section MODE switch to FM X0.1.

o. Change the Spectrum Analyzer controls as follows:

Resolution	1 kHz
Scan width per division	5 kHz

p. Verify that the display is similar to Figure 3-4.

Figure 3-2. Operator's Check (2 of 2)

Figure 3-3. Phase Modulation (ϕM) Spectrum

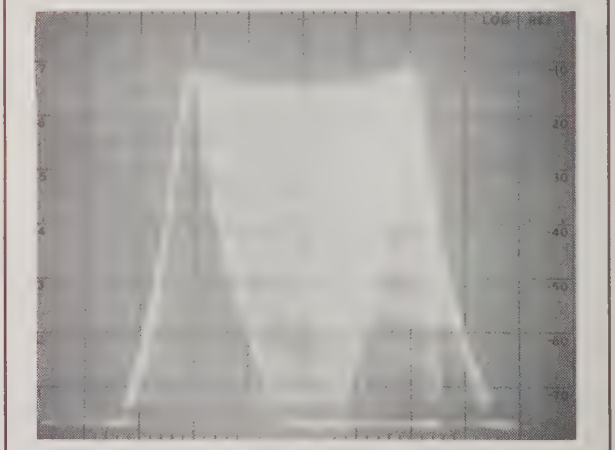
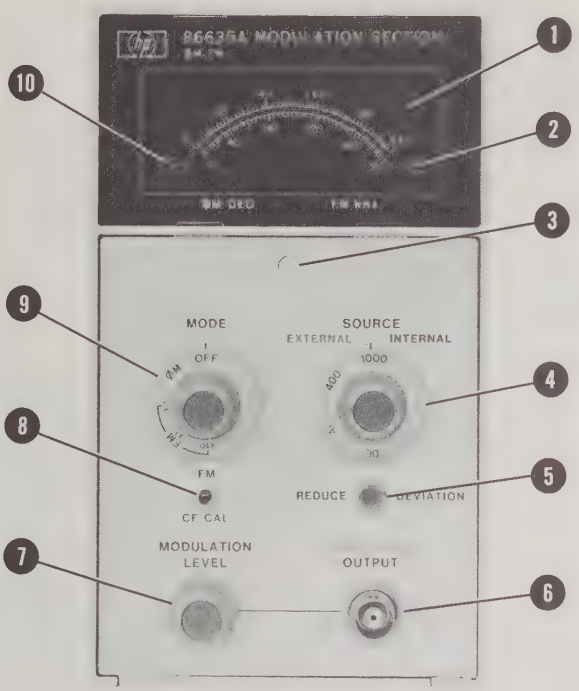


Figure 3-4. Frequency Modulation (FM) Spectrum

FRONT PANEL OPERATING INSTRUCTIONS



a. With mainframe LINE switch turned off, check position of needle on meter (1). If off zero, adjust screw (3) until meter indication is on zero. Refer to Meter Zeroing in Section II.

WARNING

BEFORE CONNECTING THIS SYSTEM TO THE LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

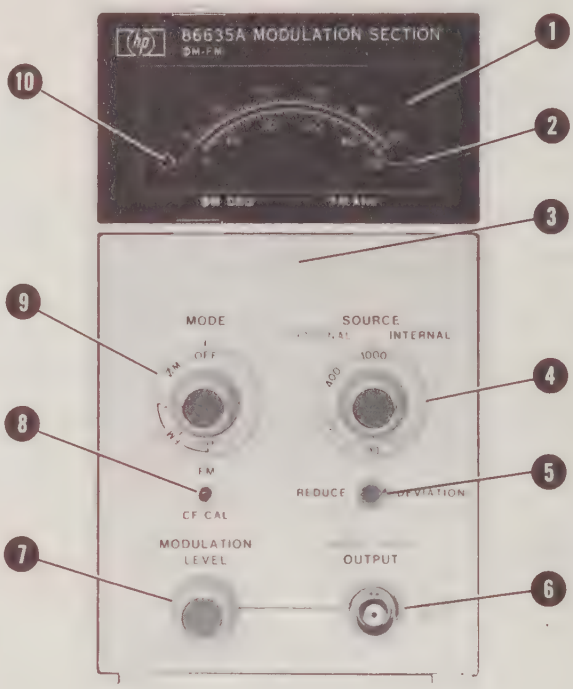
b. Turn on instrument.

c. Set modulation SOURCE switch (4) to either INTERNAL (black) or EXTERNAL (green) positions as desired.

1. For INTERNAL positions, set to either 400 or 1000 Hz. In these positions, a modulation signal (200 mVrms minimum into 10 kΩ load) for oscilloscope synchronization is provided at the OUTPUT port (6).

Figure 3-5. Front Panel Operating Instructions (1 of 2)

FRONT PANEL OPERATING INSTRUCTIONS



2. For EXTERNAL POSITIONS, the INPUT port (6) requires an external modulation signal.

   Set SOURCE switch (4) to AC for modulating signals between 20 Hz and 1 MHz (1.5 ± 0.5 Vrms).

   Set SOURCE switch (4) to DC for a modulating signal between DC and 1 MHz at 1.8 ± 0.1 Vrms).

d. Set MODE switch (9) to ϕM, FM X0.1, FM X1, or FM X10. In ϕM the meter indicates degrees deviation. In FM the meter indicates peak frequency deviation in kHz when multiplied by the indicated range factor on the MODE switch (9) knob. Lights (2) and (10) indicate the correct range to use.

e. Adjust ϕM degrees deviation or FM peak deviation with the MODULATION LEVEL control (7).

f. In FM Mode the FM CF CAL button (8) is pushed to lock the internal VCO to the mainframe reference oscillator. The calibration cycle takes about 5 seconds.

Figure 3-5. Front Panel Operating Instructions (2 of 2)

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section are used to verify that the electrical performance of the Model 86635A Modulation Section meets the specifications listed in Table 1-1. All tests can be performed without access to the interior of the instrument. A simple operational test is included in Section III under Operator's Checks.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in Table 1-2, Recommended Test Equipment. Equipment that satisfies the critical specifications given in the table may be substituted for the equipment recommended.

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection may be used for comparison in periodic maintenance, troubleshooting, and after repairs or adjustment have been made.

PERFORMANCE TESTS

4-7. INTERNAL MODULATION RATES AND OUTPUT LEVEL

SPECIFICATION: An internal modulation signal of 400 Hz or 1000 Hz ±5% at a level of 200 mVrms minimum into a 10 kΩ load is provided at the front panel BNC connector.

DESCRIPTION: This test verifies the operation of the internal modulation oscillator. Both frequency and output level of the modulation plug-in are checked.

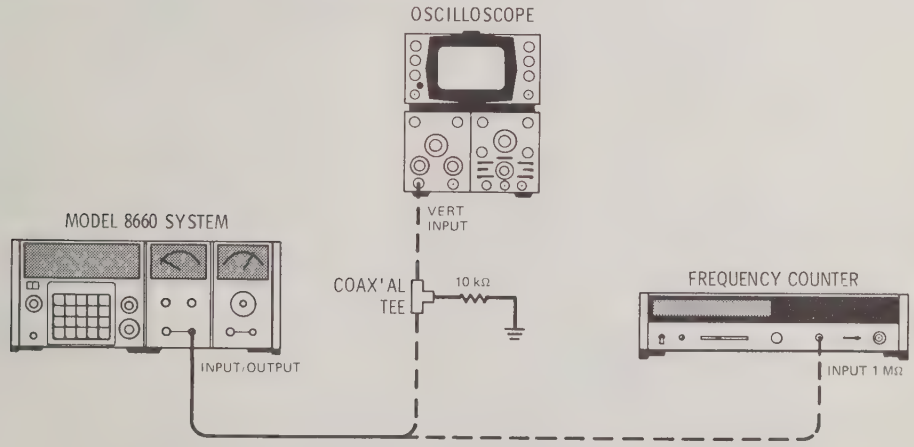


Figure 4-1. Internal Modulation Rate and Output Level Test Setup

EQUIPMENT:

Oscilloscope	HP 180C/1801A/1821A
Frequency Counter	HP 5340A
Coaxial Tee (BNC)	HP 1250-0781
10 kΩ Resistor	HP 0757-0442

PERFORMANCE TESTS

4-7. INTERNAL MODULATION RATES AND OUTPUT LEVEL (Cont'd)

PROCEDURE:

1. Connect the Modulation Section OUTPUT to the counter input.
2. Set the Model 86635A Modulation Section controls as follows: MODE to ϕM, SOURCE to 400. The counter should read 400 ± 20 Hz.

   _____ Hz
3. Change the SOURCE control to 1000. The counter should read 1000 ± 50 Hz.

   _____ Hz
4. Connect the Modulation Section OUTPUT to the oscilloscope through a BNC Tee. Load the remaining BNC Tee port with a 10K ohm resistor. The signal displayed on the oscilloscope should be a minimum of 560 mVp-p (200 mVrms).

   _____ mVp-p
5. Change the SOURCE control to 400. The signal displayed on the oscilloscope should be a minimum of 500 mVp-p (200 mVrms).

   _____ mVp-p

4-8. FM DEVIATION AND METER ACCURACY

SPECIFICATION:

Frequency Modulation:

Meter:

Indicates peak FM deviation in three ranges, 10 kHz, 100 kHz, and 1 MHz full scale for center frequencies from 1 to 1299.999999 MHz.

For center frequencies from 1300 to 2599.999998 MHz, the range of the meter is automatically changed from 0—100 to 0—200 in three ranges, 20 kHz, 200 kHz, and 2 MHz full scale.

Meter Accuracy: ±5% of full scale.

DESCRIPTION: This test verifies FM peak deviation and meter accuracy at 10 kHz and 100 kHz by setting up these deviations, as shown by the FM Discriminator, and measuring the output voltage with a Wave Analyzer.

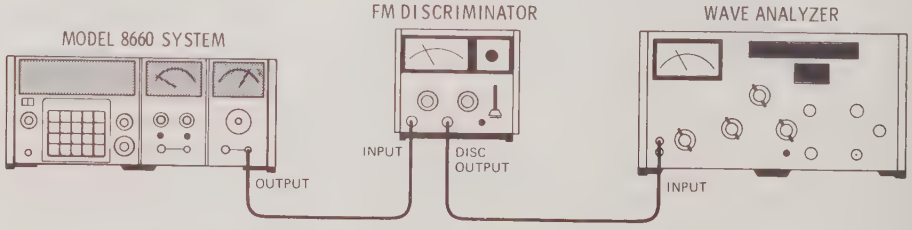


Figure 4-2. FM Deviation and Meter Accuracy Test Setup

NOTE

If a wave analyzer is not available, the first part (through step 7) of this test may be performed with a wideband voltmeter, such as the HP 3403C.

PERFORMANCE TESTS

4-8. FM DEVIATION AND METER ACCURACY (Cont'd)

EQUIPMENT:

FM Discriminator	HP 5210A
Wave Analyzer	HP 310A

PROCEDURE:

1. Set the mainframe frequency to 9 MHz and the RF Section Output to +10 dBm.
2. Set the Modulation Section controls as follows: MODE control to FM X1, SOURCE control to INTERNAL 1000, and MODULATION LEVEL control for a meter indication of 100 (100 kHz) and press the FM CF CAL switch.
3. Set the FM Discriminator to a sensitivity of 1 volt and a frequency range of 10 MHz (1 Vpk/10 MHz peak deviation).
4. Install a 20 kHz Lowpass Filter in the FM Discriminator output.
5. Calibrate the FM Discriminator output. (If the HP 5210A is used, refer to the 5210A Operating and Service Manual.)
6. Connect the equipment as shown in Figure 4-2.
7. Tune the Wave Analyzer to 1 kHz (absolute), 200 Hz BW, Max Input Voltage 0.3V and verify that the Wave Analyzer indicates an output of 7.07 ± 0.35 mVrms.

   _____ mVrms
8. Set the Modulation Section MODE switch to FM X0.1 and the MODULATION LEVEL to 100 (10 kHz).
9. Set the FM Discriminator frequency range to 100 kHz. Verify that the Discriminator output is 0.707 ±0.035 mVrms.

4-9. MODULATION DISTORTION

SPECIFICATION: **Frequency Modulation:**

Internal: Maintains minimum ϕM/FM distortion specified for RF Section used.

External: Partially determined by external modulating signal distortion. External modulating signal distortion must be less than 0.3% to meet RF Section distortion specification.

NOTES

Refer to Section IV of the RF Section in Operating and Service Manual for the distortion checks.

Typical distortion levels at the Modulation Section outputs are <1% for ϕM and <1% for FM.

PERFORMANCE TESTS

4-10. FM INPUT LEVEL AND RATE

SPECIFICATION: **AC Coupled Mode:** External modulating signal must be between 1 and 2 Vrms to provide full vernier control range and calibrated remote programming of modulation.

DC Coupled Mode: External modulation signal must be approximately 1.8 Vrms to maintain full vernier range in the local mode, and must be 1.8 Vrms ± 0.02 Vrms for calibrated remote programming of peak deviation.

FM Rate: DC to 1 MHz in DC mode, or 20 Hz to 1 MHz in AC mode. Maximum usable rate is limited by the RF Section installed, and is limited to 1/10 of selected center frequency below 10 MHz.

DESCRIPTION: This test verifies FM operation at 100 Hz and 10 kHz rates, 100 kHz and 1 MHz peak deviation. Correct operation is verified with external input levels of 1 Vrms and 2 Vrms.

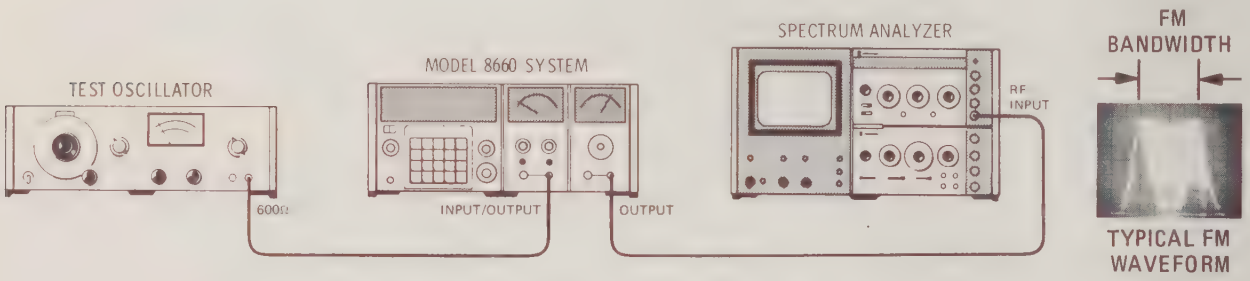


Figure 4-3. FM Input Level and Rate Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 140T/8555A/8552B
Test Oscillator	HP 651B

PROCEDURE:

1. Connect the equipment as shown in Figure 4-3.
2. Set the mainframe center frequency to 10 MHz and the RF Section output to 0 dBm.
3. Set the Spectrum Analyzer controls as follows: center frequency to 10 MHz, resolution bandwidth to 3 kHz, frequency span per division to 0.05 MHz, input attenuator to 30 dB, and sweep time per division to 0.5 second.
4. Adjust the test oscillator controls for an output of 100 Hz at 1.8 Vrms.
5. Set the Modulation Section MODE switch to FM X1, the SOURCE switch to EXTERNAL DC and adjust the MODULATION LEVEL control to 100. Then press the FM CF CAL switch to calibrate the FM oscillator.
6. Verify the 100 kHz peak deviation on the Spectrum Analyzer display as shown by a display of 200 ± 10 kHz wide. (See Figure 3-4 for a typical waveform).

Deviation _____ kHz

PERFORMANCE TESTS

4-10. FM INPUT LEVEL AND RATE (Cont'd)

7. Set the Modulation Section SOURCE control to EXTERNAL AC. Readjust test oscillator to 2.0 Vrms and readjust the MODULATION LEVEL control to 100. The Spectrum Analyzer display should again show 200 ± 10 kHz deviation.

   Deviation _____kHz

8. Set the Modulation Section MODE control to FM X10, the MODULATION LEVEL to 20 and push the FM CF CAL switch.

9. Readjust the Test Oscillator output to 10 kHz at 2.0 Vrms. Readjust the MODULATION LEVEL control for an indication of 20 on the meter.

10. Set the Spectrum Analyzer controls as follows: resolution bandwidth to 3 kHz, frequency span per division to 0.05 MHz, and sweep time per division to 0.5s.

11. The peak deviation should be 200 kHz as shown by a display 400 ± 20 kHz.

    Deviation _____ kHz

12. Readjust Test Oscillator output to 1.0 Vrms. Display should remain at 400± 20 kHz.

    Deviation _____kHz

4-11. PHASE MODULATION INPUT LEVEL AND RATE

SPECIFICATION: **AC Coupled Mode:** Full control range is possible with any modulating signal from 1 to 2 Vrms. In the external AC mode the range is 20 Hz to 1 MHz.

DC Coupled Mode: 1.8 Vrms ±0.1 Vrms for local mode, ±0.02 for calibrated remote programming.

Rate: DC to 1 MHz in DC coupled mode (maximum usable rate is limited to 0.1 of center frequency for center frequencies below 5 MHz).

DESCRIPTION: Phase modulation accuracy is verified in the external DC coupled mode by applying a signal at 1.8 Vrms and noting the indication on the meter.

Phase modulation accuracy is verified in the external AC coupled mode by applying signals of 1 Vrms and 2 Vrms levels at 1000 MHz and 1350 MHz and noting the meter indications.

PERFORMANCE TESTS

4-11. PHASE MODULATION INPUT LEVEL AND RATE (Cont'd)

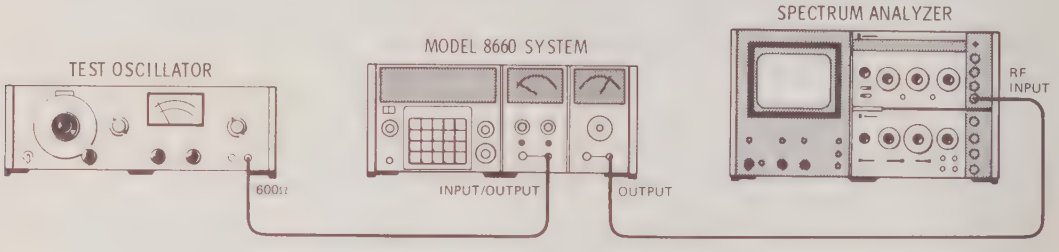


Figure 4-4. Phase Modulation Input Level and Rate Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 140T/8555A/8552B
Test Oscillator	HP 651B

PROCEDURE:

1. Connect equipment as shown in Figure 4-4.

2. Set the Test Oscillator to 1.8 Vrms ± 0.1 Vrms output at a frequency of 100 kHz. Set the Modulation Section SOURCE switch to EXTERNAL DC and the MODE switch to ϕM.

3. Set the mainframe to a center frequency of 1000 MHz and RF Section output to 0 dBm.

4. Set the Spectrum analyzer controls as follows:

CENTER FREQUENCY	1000 MHz
BANDWIDTH	10 kHz
SCAN WIDTH PER DIVISION	100 kHz
SCAN TIME PER DIVISION	5 ms
IF AMPLIFIER	LINEAR

5. Adjust the Modulation Section MODULATION LEVEL control until the center frequency and first sidebands are equal in amplitude as shown in Figure 4-5. The Modulation Section meter should indicate 82° ± 5°. _____°

6. Set the Test Oscillator to 1 Vrms output.

7. Set the Modulation Section SOURCE switch to EXTERNAL AC. Adjust the MODULATION LEVEL control until the center frequency and the first sidebands are equal in amplitude. The meter should indicate 82° ± 5°.

PERFORMANCE TESTS

4-11. PHASE MODULATION INPUT LEVEL AND RATE (Cont'd)

8. Set the mainframe center frequency to 1350.000000 MHz. Set the Test Oscillator to 500 kHz with an output of 2 Vrms. Set the Spectrum Analyzer controls as follows:

CENTER FREQUENCY	1350 MHz
BANDWIDTH	30 kHz
SCAN WIDTH PER DIVISION	500 kHz
SCAN TIME PER DIVISION	20 msec
IF AMPLIFIER	LINEAR

9. Adjust the Modulation Level control so that the carrier nulls as shown in Figure 4-6. This is 138° phase modulation. The meter should read 138° ±10° (±5% of full scale). _____°

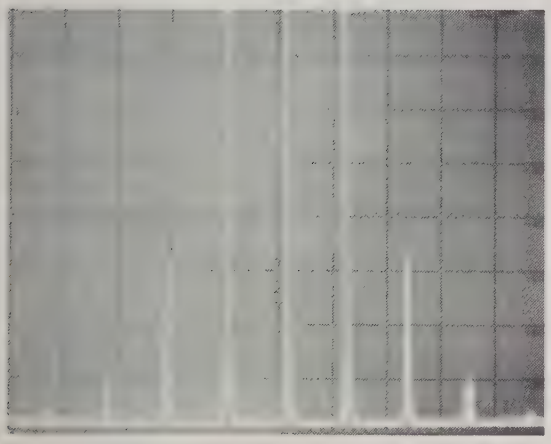


Figure 4-5. 82° Phase Modulation

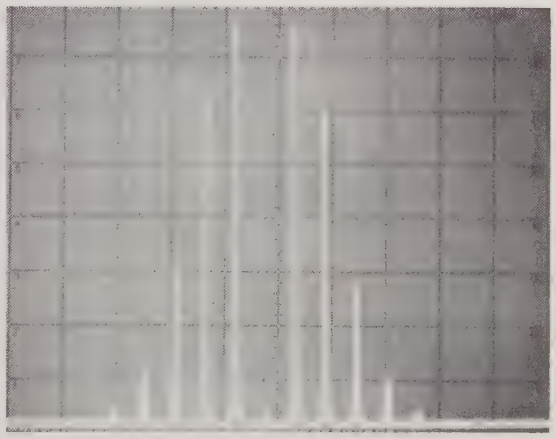


Figure 4-6. 138° Phase Modulation

4-12. REMOTE PROGRAMMING

SPECIFICATION: **Remote Modulation Setting Resolution:** Modulation level can be remotely set in steps of 1/50 of the range selected. Refer to Table 3-3.

Remote Modulation Setting Accuracy: ±5% of full range (up to 20 kHz in FM)
±5% of full range (up to 100 kHz in ϕM)
±8% of full range (up to 1 MHz in ϕM)

DESCRIPTION: Operation of the instrument in remote control mode is verified by programming a series of modulation functions with a remote device.

PERFORMANCE TESTS

4-12. REMOTE PROGRAMMING (Cont'd)

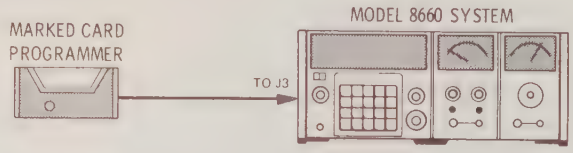


Figure 4-7. Remote Programming Test Setup

EQUIPMENT: Marked Card Programmer . . . . . HP 3260A, Option 001

PROCEDURE:

1. Connect the Marked Card Programmer to the mainframe programming input connector (J3) on the rear panel of the mainframe. Refer to Section III of the mainframe manual for programming instructions.

2. Program the Modulation Section to FM X1 mode, Internal 400 source and a peak deviation of 0 kHz.

3. In sequence, on separate cards, program 1 kHz, 10 kHz, and 100 kHz peak deviation. As each level is programmed into the system, verify that the change in meter reading is proportional to the change in the programmed level.

0.95 _____ 1.05 kHz
9.5 _____ 1.05 kHz
95 _____ 105 kHz

Table 4-1. Performance Test Record

Hewlett-Packard Model 86635A
Modulation Section

Tested by _____

Serial Number _____

Date _____

Para. No.	Test	Results		
		Min.	Actual	Max.
4-7.	**INTERNAL MODULATION RATES AND OUTPUT LEVEL**			
	400 Hz	380 Hz	_____	420 Hz
	1000 Hz	950 Hz	_____	1050 Hz
	400 Hz	560 mVp-p	_____	—
	1000 Hz	560 mVp-p	_____	—
4-8	**FM DEVIATION AND METER ACCURACY**			
		6.72 mVrms	_____	7.42 mVrms
		0.672 mVrms	_____	0.742 mVrms
4-10.	**FM INPUT LEVEL AND RATE**			
	200 kHz	190 kHz	_____	210 kHz
	200 kHz	190 kHz	_____	210 kHz
	400 kHz	380 kHz	_____	420 kHz
	400 kHz	380 kHz	_____	420 kHz
4-11.	**PHASE MODULATION INPUT LEVEL AND RATE**			
	82°	77°	_____	87°
	138°	128°	_____	148°

MODULATION SECTION ØM-FM

MANUAL IDENTIFICATION

Model Number: 86635A
Date Printed: April 1977
Part Number: 86635-90005

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
► 1734A	

Serial Prefix or Number	Make Manual Changes

► NEW ITEM

ERRATA

Page 5-1, Table 5-1, Factory Selected Components:

Add reference designator A3R38. Basis of selection, measure amplitude of modulating signal out of the A3 assembly ≈ 0.90V for 90% modulation in the ϕM Mode. Range of values 825Ω to 1 KΩ. Service Sheet 5.

Add reference designator A9C4. Basis of selection is compensation for gain versus frequency of the phase modulation output amplifier. Measure amplitude of modulating signal out of the A3 ≈ 0.90V for 90% modulation in the ϕM mode. Range of values 30 pF to 51 pF.

Page 6-5, Table 6-2:

Change A3Q1 to 1853-0451 TRANSISTOR PNP 2N3799 SI TO-18 PD=360 mW.

Page 6-6, Table6-2, Replaceable Parts:

Change A3R38 to a star (*) value, 0757-0422 RESISTOR 909 1% .125W F TC=0+—100.

Exchange HP Part Numbers and Description for A4Q1 and A4Q2.

Page 6-9, Table 6-2, Replaceable Parts:

Change A6R25 to 2100-1758 RESISTOR VAR, TRMR 1KΩ 5% WW SIDE-ADJ 1-TRN.

Page 6-13, Table 6-2, Replaceable Parts:

Change A9C4 to a star (*) value, 0140-0190 CAPACITOR FXD 39 PF +—5%, 300 VDC.

A9R2 to 0757-0402 RESISTOR 110 1% .125W F TC=0 + —100.

A9R7 to 0757-1094 RESISTOR 1.47K 1% .125W F TC=0 + —100.

A9R11 to 0698-3430 RESISTOR 21.5 1% .125W F TC=0 + —100.

Continued . . . .

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

5 October 1977
2 Pages

HEWLETT hp PACKARD

Printed in U.S.A.

ERRATA (cont'd)

Page 8-19, Figure 8-11, Service Sheet 4:
Change Q1 to Q2 and Q2 to Q1, part numbers remain as they are.

Page 8-21, Figure 8-14, Service Sheet 5 (schematic):
Change A3R38 to 909 and add star (*), factory selected component.
Change Q1 to 1853-0451.

Page 8-23, Figure 8-17, Service Sheet 6 (schematic):
Change A6R25 to 1000.

Page 8-27, Figure 8-22, Service Sheet 8 (schematic):
Change A9C4 to 39 pF and add star (*), factory selected component.
A9R2 to 110
A9R7 to 1470
A9R11 to 21.5.

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes adjustments and checks required to return the Model 86635A to peak operating capability when repairs have been made. Adjustment locations are identified pictorially on a Section VIII foldout service sheet.

5-3. RECOMMENDED TEST EQUIPMENT

5-4. Each adjustment procedure in this section contains a list of test equipment and accessories required to perform the procedure. Each test setup identifies test equipment and accessories by call-outs.

5-5. To ensure that the Modulation Section is operating at peak capability, it is important that the test equipment used meets the minimum specifications stipulated in Table 1-2.

5-6. The HP 11672A Service Kit (see paragraph 1-31) includes cables and adapters for troubleshooting the Modulation Section. The extender boards (supplied with the mainframe) provide access to test points and circuit boards to aid in servicing.

5-7. FACTORY SELECTED COMPONENTS

5-8. Factory selected components are identified on the schematics by an asterisk following the reference designator. The nominal value is listed on the schematic, in Tables 5-1 and 6-3. Usually these values are not extremely critical; they are selected to provide optimum compatability with associated components. Table 5-1 includes the basis for selection, the range of values, and the service sheet where the selected component is located.

5-9. RELATED ADJUSTMENTS

5-10. Because of the interaction of certain adjustable components, the Amplitude Leveling Adjustment must be performed before the Remote Modulation Signal Level and Meter Adjustments. The Amplitude Leveling Adjustments must also be performed before the FM Deviation Attenuator Adjustment.

5-11. ADJUSTMENT LOCATIONS

5-12. The location of each adjustable component is shown on the service sheet reference in the individual procedures.

NOTE

For all adjustments the Modulation Section, with the cover removed, should be connected to the mainframe with the extender cable (HP 11672-60002).

Table 5-1. Factory Selected Components

Reference Designator	Basis of Selection	Range of Values	Service Sheet
A4R46	Selected for centering the adjustment range of A4R45. Adjust A4R45 to center of travel. With a 100 kHz 1.5 Vrms signal applied to front panel J1 select A4R6 for a 1.8 ± 0.01 Vrms at A4TPB.	31.6kΩ to 49.9kΩ	4
A6R32	The dc offset tolerance at A6PT4 on the A6 Assembly must be 0 Vdc ± 12 mVdc. Test conditions: MODE—FM, SOURCE—DC, MODULATION LEVEL—full CW with no input. Increasing the value of the resistor decreases the voltage.	6—24Ω	6
A7A3C17	With the input to A7A3Q7 grounded (at the insulated standoff) and the Frequency Control A7A3R10 set for an oscillator output of 20.000 MHz, the selected capacitor causes the voltage at A7A3TP1 to be +6.0 ± 0.5 Vdc.	1 to 8.2 pF	7

5-13. SAFETY CONSIDERATIONS

5-14. Although this instrument has been designed in accordance with international safety standards, this manual contains information and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition. Service and adjustments should be performed only by qualified service personnel.

5-15. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. The opening of covers, or removal of parts or plug-ins may expose live parts and also accessible terminals may be live.

5-16. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

5-17. Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement in the mainframe. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

5-18. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation by placing a tag over the mainframe on-off switch indicating the nature of the impairment.

5-19. POST-REPAIR TEST AND ADJUSTMENTS

5-20. The adjustments in this section should be performed when the troubleshooting information in Section VIII indicates that an adjustable circuit is not operating correctly. Perform the adjustments AFTER repairing or replacing the circuit. Allow the instrument to warm up one hour before making any adjustment.

5-21. After making the adjustments, the performance tests found in Section IV can be used to verify that the instrument is operating correctly.

ADJUSTMENTS

5-22. MODULATION OSCILLATOR ADJUSTMENT

REFERENCE: Service Sheet 3.

DESCRIPTION: The INTERNAL 400 and 1000 Hz oscillators are adjusted to the correct frequency by using a Frequency Counter.

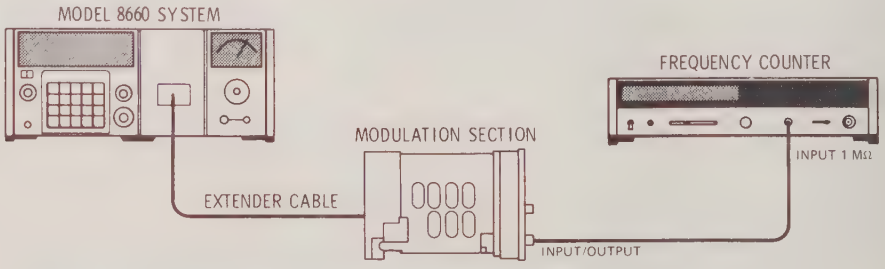


Figure 5-1. Modulation Oscillator Adjustment Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
Extender Cable	HP 11672-60002

PROCEDURE:

1. Connect the equipment as shown in Figure 5-1.
2. Set the MODE control to ϕM and the SOURCE control to 400.

ADJUSTMENTS

5-22. MODULATION OSCILLATOR ADJUSTMENT (Cont'd)

3. Adjust A5R15 for a counter reading of 400 ± 4 Hz.

4. Set the SOURCE control to 1000.

5. Adjust A5R16 for a counter reading of 1000 ± 10 Hz.

5-23. AMPLITUDE LEVELING ADJUSTMENT

REFERENCE: Service Sheet 4.

DESCRIPTION: When properly adjusted, a constant output of 1.80 Vrms is provided by the leveling amplifier with an External AC input of 1 to 2 Vrms.

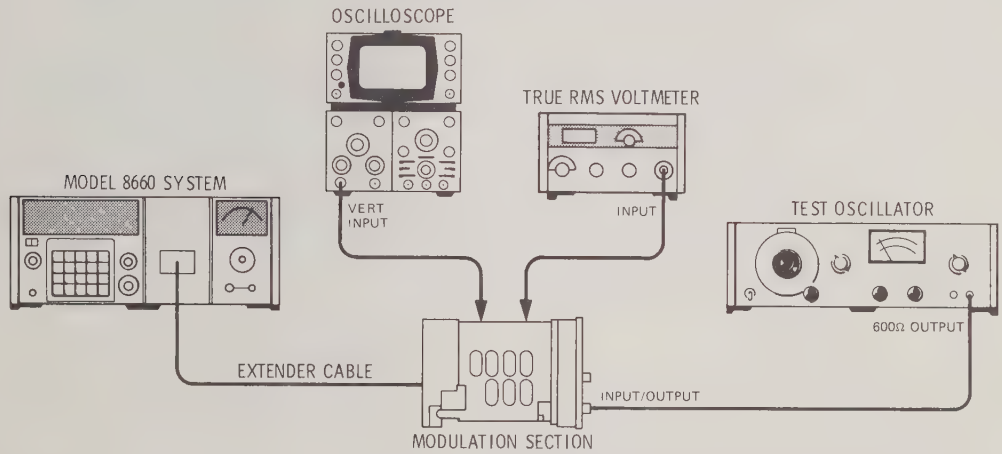


Figure 5-2. Amplitude Leveling Adjustment Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
Oscilloscope	HP 180C/1801A/1821A
True RMS Voltmeter	HP 3403C
Extender Cable	HP 11672-60002

PROCEDURE:

NOTE

Unless A4U1 or an associated component has been replaced, A4R5, which has been adjusted at the factory, should not have to be readjusted.

1. Remove the A4 Assembly and reinstall it using an extender board and connect the equipment as shown in Figure 5-2.

2. Set the Modulation Section SOURCE control to EXTERNAL AC.

ADJUSTMENTS

5-23. AMPLITUDE LEVELING ADJUSTMENT (Cont'd)

3. Set the Test Oscillator frequency to 10 kHz with an output level of 1.5 Vrms.

4. Set the oscilloscope vertical sensitivity to 0.1 volts per division.

5. Connect the oscilloscope to the negative side of A4C11 (A4TPB) through a 10:1 divider probe.

6. Adjust A4R45 for maximum gain without oscillation. The signal should be greater than 2.65 Vp-p.

7. Set the Modulation Section MODE switch to ϕM and the SOURCE switch to 1000. Connect AC Voltmeter to A4TPB. Adjust A4R35 for a reading of 1.80 Vrms ± 0.01 Vrms on the AC Voltmeter.

5-24. REMOTE MODULATION SIGNAL LEVEL AND METER ADJUSTMENTS

REFERENCE: Service Sheet 5.

DESCRIPTION: The following procedure requires a remote programming capability for adjusting the remote modulation signal level. The meter is first adjusted for mechanical zero. Then, the dc offset is adjusted for the best zero compromise above and below 1300 MHz. Next overall gain of the modulation signal is set and then the meter gain is adjusted. If remote programming is not available, and is not to be used, use the alternate procedure for adjusting the meter circuits beginning with step 1a.

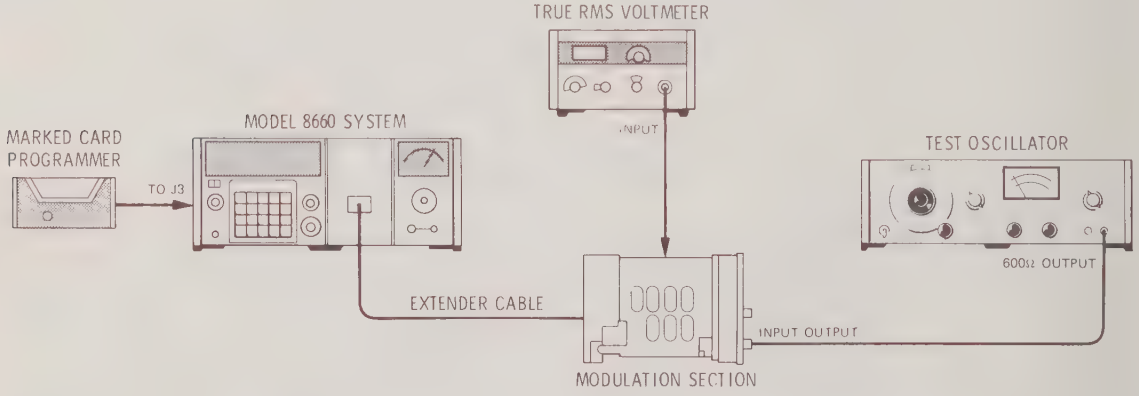


Figure 5-3. Remote Modulation Signal Level and Meter Adjustment Test Setup

EQUIPMENT:

True RMS Voltmeter	HP 3403C
Test Oscillator	HP 651B
Marked Card Programmer	HP 3260A, Option 001
Extender Cable	HP 11672-60002

ADJUSTMENTS

5-24. REMOTE MODULATION SIGNAL LEVEL AND METER ADJUSTMENTS (Cont'd)

PROCEDURE:

1. If the meter needle is not on zero with the mainframe power off, turn the mechanical setscrew adjustment counterclockwise to bring the needle below zero. Slowly rotate the zero setscrew clockwise until the needle is on zero. Then rotate the zero setscrew about 1/12 turn (30°) counterclockwise.

2. Connect the equipment as shown in Figure 5-3. Remove the A3 Assembly and reinstall it using an extender board.

3. Turn on the equipment and remotely program the Modulation Section for ϕM MODE and EXTERNAL DC SOURCE.

4. Program the mainframe center frequency to 1350.000000 MHz.

5. Connect the voltmeter to A3TP1.

6. With no output from the test oscillator, adjust A3R6 (ZERO ADJ.) for an indication of 0V on the voltmeter.

7. Program the mainframe center frequency to 1000.000000 MHz and repeat step 6. Repeat steps 6 and 7 as required for an indication of 0V ± 5 mVdc on the digital voltmeter. Disconnect the digital voltmeter.

8. Set the test oscillator for 100 kHz at 1.8 Vrms.

9. Program the Modulation Section for 90° phase modulation and EXTERNAL AC SOURCE. Program the mainframe center frequency to 1000.000000 MHz.

10. Connect the voltmeter to A9TP1.

11. Adjust A3R37 (GAIN ADJ.) for an indication of 1.35 Vrms on the voltmeter.

12. Adjust A3R36 (METER ADJ.) for an indication of 90° on the Modulation Section meter. Remove the extender board and reinstall the A3 Assembly.

5-24a. ALTERNATE METER ADJUSTMENT PROCEDURE IF REMOTE PROGRAMMING IS NOT USED

NOTE

Use of this procedure results in an uncalibrated programmed output although the meter will indicate the correct modulation level.

1a. Perform steps 1 and 2 except without the Marked Card Programmer.

2a. Turn on the equipment and set the Modulation Section MODE switch to ϕM and the SOURCE switch to DC.

3a. Set the mainframe center frequency to 1350.000000 MHz.

ADJUSTMENTS

5-24a. ALTERNATE METER ADJUSTMENT PROCEDURE IF REMOTE PROGRAMMING IS NOT USED (Cont'd)

4a. Connect the voltmeter to A3TP1.

5a. With no output from the test oscillator, adjust A3R6 (ZERO ADJ.) for an indication of 0V on the voltmeter.

6a. Set the mainframe center frequency to 1000.000 MHz and repeat step 5a. Repeat steps 5a and 6a as required for an indication of 0V ±5 mVdc on the voltmeter. Disconnect the voltmeter.

7a. Set the test oscillator for 100 kHz at 1.8 Vrms.

8a. Adjust the MODULATION LEVEL control for an indication of 1.35 mVrms on the voltmeter.

9a. Adjust A3R36 (METER ADJ.) for an indication of 90° on the Modulation Section meter. Remove the extender board and reinstall the A3 Assembly.

5-25. REDUCE DEVIATION LAMP ADJUSTMENT

REFERENCE: Service Sheet 8.

DESCRIPTION: The REDUCE DEVIATION lamp is activated at approximately 110% of meter full scale. This procedure adjusts the level at which the lamp lights.

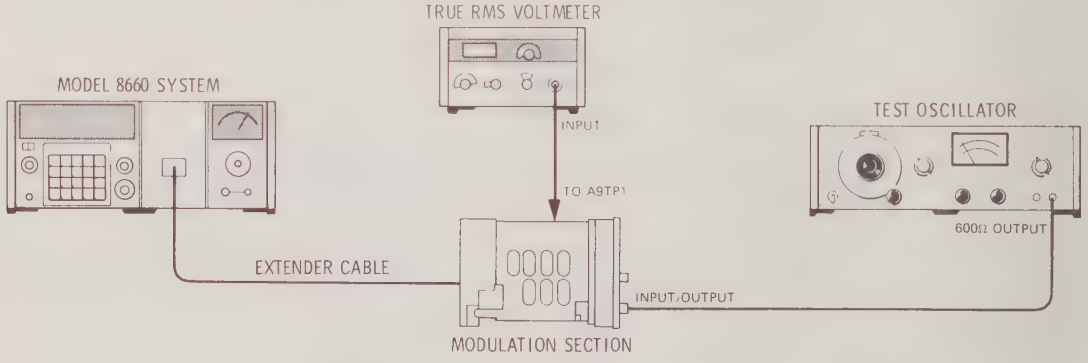


Figure 5-4. Reduce Deviation Lamp Adjustment Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
Extender Cable	HP 11672-60002
True RMS Voltmeter	HP 3403C

PROCEDURE:

1. Connect the equipment as shown in Figure 5-4.
2. Set Modulation Section MODE switch to ϕM and SOURCE switch to AC.
3. Turn on the instruments and set mainframe center frequency to 1350.000000 MHz.

ADJUSTMENTS

5-25. REDUCE DEVIATION LAMP ADJUSTMENT (Cont'd)

4. Set the Test Oscillator for a 100 kHz output at 1.5 Vrms.

5. Adjust the Modulation Section MODULATION LEVEL control for an indication of 1.65 Vrms on the voltmeter.

6. Adjust A9R12 (REDUCE DEVIATION LAMP ADJ.) until the REDUCE DEVIATION lamp flickers and then reajust until the lamp just stays on.

7. Reduce the MODULATION LEVEL control and verify that the lamp goes out before a 1.60 Vrms indication is reached. If not, repeat steps 6 and 7.

5-26. FM DEVIATION ATTENUATOR ADJUSTMENT

REFERENCE: Service Sheet 6.

DESCRIPTION: The FM range selector circuit is set to zero dc offset with no modulation input. FM sensitivity is then calibrated at 1 MHz peak deviation.

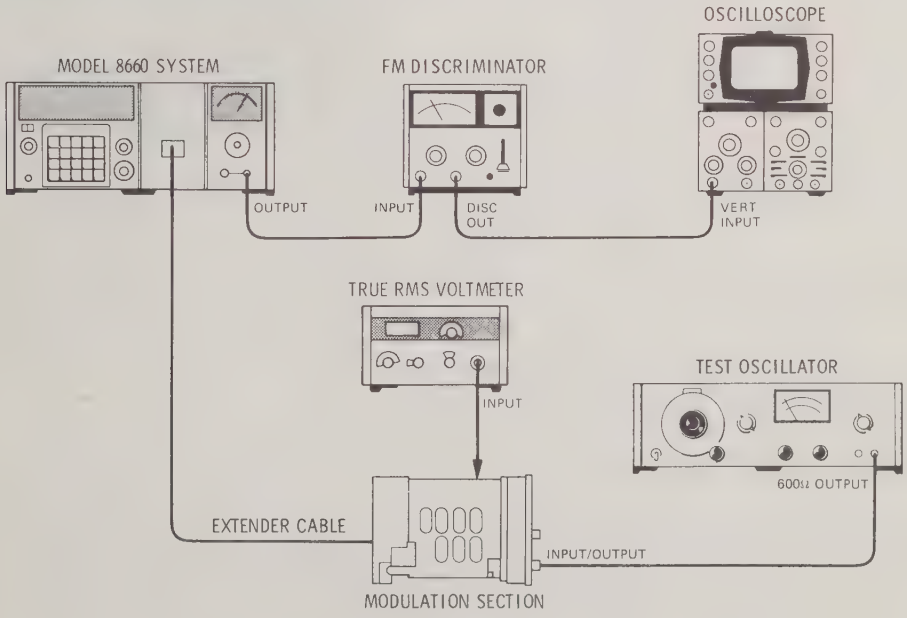


Figure 5-5. FM Deviation Attenuator Adjustment Test Setup

EQUIPMENT:

True RMS Voltmeter	HP 3403C
Test Oscillator	HP 651B
Oscilloscope	HP 180C/1801A/1821A
Extender Cable	HP 11672-60002
FM Discriminator	HP 5210A

ADJUSTMENTS

5-26. FM DEVIATION ATTENUATOR ADJUSTMENT (Cont'd)

PROCEDURE:

1. Set the MODE switch to FM X0.1, the SOURCE switch to DC, and the MODULATION LEVEL control fully clockwise. Connect equipment as shown in Figure 5-5.

NOTE

There is no input to the Modulation Section for the next two steps.

2. Connect the voltmeter to A6TP2 and adjust A6R20 "ZERO-1" for a reading of 0 ± 1 mV.
3. Connect the voltmeter to A6TP3 and adjust A6R23 "ZERO-2" for a reading of 0 ± 1 mV. Disconnect the voltmeter.
4. Set the FM Discriminator to a sensitivity of 1V and a range of 10 MHz.
5. Install a 20 kHz low-pass filter at the discriminator output and calibrate the FM Discriminator output. (Refer to the Frequency Meter/FM Discriminator Operating and Service Manual for instructions.)
6. Set the mainframe center frequency to 8 MHz and the RF Section output to +10 dBm.
7. Set the MODE switch to FM X10 and the SOURCE switch to AC.
8. Set the Test Oscillator frequency to 1 kHz and an output amplitude of 1 Vrms.
9. Reconnect the equipment as shown in Figure 5-5.
10. Adjust the MODULATION LEVEL control for a reading of 100 on the meter.
11. Adjust A6R25 "FM-SEN" to show a 0.2 Vp-p display on the oscilloscope.

5-27. VCO CENTER FREQUENCY ADJUSTMENT

REFERENCE: Service Sheet 7.

DESCRIPTION: The 20 MHz VCO frequency is adjusted as the output of the RF Section is monitored on a Frequency Counter. With the Model 86635A in the FM mode (0 deviation) the counter readout should be the same as the mainframe center frequency ± 5 kHz. Control A7A1R13 is adjusted to reduce center frequency shift after an FM calibration cycle.

ADJUSTMENTS

5-27. VCO CENTER FREQUENCY ADJUSTMENT (Cont'd)

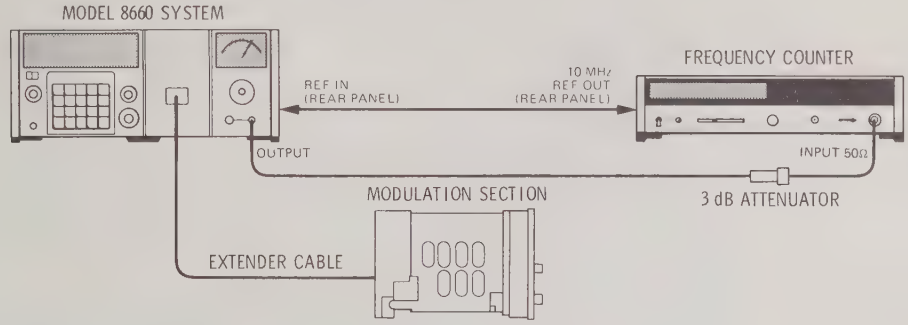


Figure 5-6. VCO Center Frequency Adjustment Test Setup

EQUIPMENT:

Frequency Counter	HP 5340A
Extender Cable	HP 11672-60002
Attenuator (3 dB pad)	HP 8491A, Option 003

PROCEDURE:

1. Connect the equipment as shown in Figure 5-6.
2. Set the mainframe REF switch to EXT.
3. Remove the A7A3 VCO cover on the rear panel of the Modulation Section.
4. Turn the MODE switch OFF.
5. Set the mainframe center frequency to 10 MHz and the RF Section output to +10 dBm.
6. Set the MODE switch to FM X1 and the SOURCE switch to AC with no input applied.
7. Ground the teflon insulated standoff on A7A3 and record the counter reading.

   _____ MHz
8. Remove the ground clip, replace the A7A3 cover with two screws, and record the counter reading.

   _____ MHz
9. Record the difference frequency between step 7 and 8.

   _____ MHz
10. Remove the A7A3 cover. If the frequency in step 7 was higher than that in step 8, adjust A7A3R8 for a reading on the counter of 10 MHz plus the difference frequency. If the frequency in step 7 was lower than that in step 8, adjust A7A3R8 for a reading on the counter of 10 MHz less the difference frequency.
11. Measure the voltage at A7A3TP1. If the voltage is +6.0 ± 0.5 Vdc, proceed to step 14.

ADJUSTMENTS

5-27. VCO CENTER FREQUENCY ADJUSTMENT (Cont'd)

12. If the voltage is high, replace A7A3C17 with a higher value. With a low voltage, the value should be decreased.

13. Repeat steps 7 through 12 until the A7A3TP1 voltage is within the required tolerance.

14. Replace the A7A3 cover and recheck the frequency. The counter readout should display 10.000 MHz ±0.005 MHz (±5 kHz). If the frequency is not within tolerance, repeat steps 7 through 13.

15. Push the FM CF CAL pushbutton. The counter should indicate 10.000000 MHz ± 1 Hz for 5 seconds. After the 5 seconds calibration cycle, note the new center frequency reading.

_____ MHz

16. If the difference frequency is greater than 100 Hz, carefully adjust A7A1R13 for a difference frequency of less than 100 Hz.

17. Repeat steps 15 and 16 until the difference frequency is less than 100 Hz.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designation order. Table 6-3 contains the names and addresses that correspond with the manufacturers' code numbers.

6-3. ABBREVIATIONS

6-4. Table 6-1 lists abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviations are used, one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) used in the instrument.

c. The description of the part.

d. A typical manufacturer of the part in a five-digit code.

e. The manufacturer's number for the part.

The total quantity for each part is given only once at the first appearance of the part number in the list.

6-7. ORDERING INFORMATION

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-10. SPARE PARTS KIT

6-11. Stock spare parts for an instrument is often done to ensure quick return to service after a malfunction occurs. Hewlett-Packard has a Spare Parts Kit available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the Recommended Spares list are based on failure reports and repair data, and parts support for one year. A Recommended Spares list for this instrument may be obtained, and the Spare Parts Kit may be ordered, through your nearest Hewlett-Packard office.

6-12. DIRECT MAIL ORDER SYSTEM

6-13. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices — to provide these advantages, a check or money order must accompany each order.

6-14. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor: SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezo-electric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
. . .' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-1. Reference Designations and Abbreviations (2 of 2)

MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
μA . . . . . microampere
μF . . . . . microfarad
μH . . . . . microhenry
μmho . . . . . micromho
μs . . . . . microsecond
μV . . . . . microvolt
μVac . . . . . microvolt, ac
μVdc . . . . . microvolt, dc
μVpk . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . . microvolt, rms
μW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
NI PL . . . . . nickel plate
N/O . . . . . normally open
NOM . . . . . nominal
NORM . . . . . normal
NPN . . . negative-positive-negative
NPO . . . . negative-positive zero (zero temperature coefficient)
NRFR . . not recommended for field replacement
NSR . . . . . not separately replaceable
ns . . . . . nanosecond
nW . . . . . nanowatt
OBD . . . order by description
OD . . . . . outside diameter
OH . . . . . oval head
OP AMPL . . . operational amplifier
OPT . . . . . option
OSC . . . . . oscillator
OX . . . . . oxide
oz . . . . . ounce
Ω . . . . . ohm
P . . . . peak (used in parts list)
PAM . . . . pulse-amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . . . pulse-duration modulation
pF . . . . . picofarad
PH BRZ phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . . pulse-repetition frequency
PRR . . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . . pulse-time modulation
PWM . . . . . pulse-width modulation
PWV . . . . . peak working voltage
RC . . . . . resistance-capacitance
RECT . . . . . rectifier
REF . . . . . reference
REG . . . . . regulated
REPL . . . . . replaceable
RF . . . . . radio frequency
RFI . . . . radio frequency interference
RH . . . . round head; right hand
RLC . . . . . resistance-inductance-capacitance
RMO . . . rack mount only
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
R&P . . . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . . . second (time)
. . . " . second (plane angle)
S-B . . . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . . . selenium
SECT . . . . . sections
SEMICON . . . . . semiconductor
SHF . . . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . . single-pole, single-throw
SSB . . . . . single sideband
SST . . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing-wave ratio
SYNC . . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TD . . . . . time delay
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . . transistor
TTL . . transistor-transistor logic
TV . . . . . television
TVI television interference
TWT . . traveling wave tube
U . . . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . . volts, filtered
VFO . . variable-frequency oscillator
VHF . . . . . very-high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . . voltage-tuned oscillator
VTVM . . . . vacuum-tube voltmeter
V(X) . . . . . volts, switched
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium-iron-garnet
Z_o . . . . . characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	86635-60003	1	BOARD ASSY, FRONT HARNESS	28480	86635-60003
A1CR1	1901-0039	2	DIODE-SWITCHING 50V 300MA 5NS	28480	1901-0039
A1CR2	1901-0039		DIODE-SWITCHING 50V 300MA 5NS	28480	1901-0039
A1R1	0698-3437	5	RESISTOR 133 1% .125W F TC=0+-100	03298	C4-1/8-T0-133R-F
A1R2	0698-3437		RESISTOR 133 1% .125W F TC=0+-100	03298	C4-1/8-T0-133R-F
A1S1	3100-3030	1	SWITCH-RTRY .812 IN CTR SPCG IDX-ANG=45	28480	3100-3030
A1S2	3100-3031	1	SWITCH-RTRY .812 IN CTR SPCG IDX-ANG=60	28480	3100-3031
A1W1	8120-1733	1	CABLE ASSY 26AWG 16-CNDCT	28480	8120-1733
A2	86635-60002	1	BOARD ASSY, SWITCH LOGIC	28480	86635-60002
A2C1	0160-2055	42	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C2	0180-0228	2	CAPACITOR-FXD 22UF+-10% 15VDC TA	0420J	150D226X9015B2
A2C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2CR1	1901-0040	51	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2J1	1200-0507	1	SOCKET-IC 16-CONT DIP-SLDR	06776	0002811
A2L1	9140-0142	1	COIL-MLD 2.2UH 10% Q=32 .095DX.25LG	02178	09-4436-4K
A2R1	0698-0084	5	RESISTOR 2.15K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2151-F
A2R2	0757-0416	10	RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R3	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R4	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R5	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R6	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R7	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R8	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2R9	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A2U1	1820-0535	3	IC DRVR TTL AND DUAL 2-INP	0340F	LM75451AN
A2U2	1820-0174	3	IC INV TTL HEX 1-INP	0223G	7404PC
A2U3	1820-0054	1	IC GATE TTL NAND QUAD 2-INP	0223G	7400PC
A2U4	1820-0710	2	IC MUXR/DATA-SEL TTL L 2-TO-1-LINE QUAD	0379D	93L22PC
A2U5	1820-0659	4	IC SHF-RGTR TTL L D-TYPE PRL-IN PRL OUT	0223G	93L00PC
A2U6	1820-0659		IC SHF-RGTR TTL L D-TYPE PRL-IN PRL OUT	0223G	93L00PC
A2U7	1820-0710		IC MUXR/DATA-SEL TTL L 2-TO-1-LINE QUAD	0379D	93L22PC
A2U8	1820-0782	1	IC GATE TTL NOR TPL 3-INP	0223G	7427PC
A2U9	1820-0659		IC SHF-RGTR TTL L D-TYPE PRL-IN PRL OUT	0223G	93L00PC
A2U10	1820-0659		IC SHF-RGTR TTL L D-TYPE PRL-IN PRL OUT	0223G	93L00PC
A2U11	1820-0256	2	IC BFR DTL NAND QUAD 2-INP	0203G	MC858P
A2U12	1820-0328	1	IC GATE TTL NOR QUAD 2-INP	0223G	7402PC
A2U13	1820-0256		IC BFR DTL NAND QUAD 2-INP	0203G	MC858P
A2U14	1820-0174		IC INV TTL HEX 1-INP	0223G	7404PC
A2U15	1820-0174		IC INV TTL HEX 1-INP	0223G	7404PC
A2U16	1820-0535		IC DRVR TTL AND DUAL 2-INP	0340F	LM75451AN
			A2 MISCELLANEOUS		
	0360-1514	11	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	1480-0073	12	PIN:DRIVE 0.250" LG	0000J	OBD
	4040-0748	6	EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0750	1	EXTRACTOR-PC BOARD RED POLYC	28480	4040-0750
A3†	86635-60013	1	BOARD ASSY, REMOTE ATTENUATOR	28480	86635-60013
A3C1	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C2	0180-0116	12	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A3C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C6	0160-4084	4	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3C7	0160-4084		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3C8	0160-4084		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A3C9	0160-3876	1	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3C10	0180-1715	1	CAPACITOR-FXD 150UF+-10% 6VDC TA	0420J	150D157X9006R2
A3C11	0160-4247	2	CAPACITOR-FXD .047UF +-20% 100VDC CER	28480	0160-4247
A3C12	0160-4247		CAPACITOR-FXD .047UF +-20% 100VDC CER	28480	0160-4247
A3C13	0160-3874	2	CAPACITOR-FXD 10PF +-.5PF 200VDC	28480	0160-3874
A3C14	0160-3874		CAPACITOR-FXD 10PF +-.5PF 200VDC	28480	0160-3874

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR9	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR10	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR14	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR15	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR16	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3K1	0490-0916	9	RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A3K2	0490-1013	17	RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K3	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K4	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K5	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K6	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K7	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K8	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K9	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K10	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A3K11	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K12	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K13	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3K14	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A3L1	9140-0179	12	COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A3L2	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A3L3	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A3Q1	1853-0050	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0050
A3Q2	1853-0020	8	TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A3Q3	1854-0071	15	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3R1	0757-0418	5	RESISTOR 619 1% .125W F TC=0+-100	03298	C4-1/8-T0-619R-F
A3R2	0757-0418		RESISTOR 619 1% .125W F TC=0+-100	03298	C4-1/8-T0-619R-F
A3R3	0683-6855	1	RESISTOR 6.8M 5% .25W FC TC=-900/+1100	01606	CB6855
A3R4	0757-0288	4	RESISTOR 9.09K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-9091-F
A3R5	0698-4037	2	RESISTOR 46.4 1% .125W F TC=0+-100	03298	C4-1/8-T0-46R4-F
A3R6	2100-2632	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	0365A	ET50X101
A3R7	0757-0288		RESISTOR 9.09K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-9091-F
A3R8	0698-0083	2	RESISTOR 1.96K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1961-F
A3R9	0698-3444	15	RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A3R10	0757-0401	12	RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A3R11	0698-3446	2	RESISTOR 383 1% .125W F TC=0+-100	03298	C4-1/8-T0-383R-F
A3R12	0757-0420	1	RESISTOR 750 1% .125W F TC=0+-100	03298	C4-1/8-T0-751-F
A3R13	0757-1094	4	RESISTOR 1.47K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1471-F
A3R14	0757-0280	16	RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A3R15	0698-3153	2	RESISTOR 3.83K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3831-F
A3R16	0757-0440	2	RESISTOR 7.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-7501-F
A3R17	0698-3156	3	RESISTOR 14.7K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1472-F
A3R18	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A3R19	0757-0294	1	RESISTOR 17.8 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-17R8-F
A3R20	0757-0394	1	RESISTOR 51.1 1% .125W F TC=0+-100	03298	C4-1/8-T0-51R1-F
A3R21	0698-3437		RESISTOR 133 1% .125W F TC=0+-100	03298	C4-1/8-T0-133R-F
A3R22	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A3R23	0698-3439	1	RESISTOR 178 1% .125W F TC=0+-100	03298	C4-1/8-T0-178R-F
A3R24	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A3R25	0757-0317	2	RESISTOR 1.33K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1331-F
A3R26†	0757-0442	11	RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A3R27	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A3R28	0698-3443	1	RESISTOR 287 1% .125W F TC=0+-100	03298	C4-1/8-T0-287R-F
A3R29	0698-3446		RESISTOR 383 1% .125W F TC=0+-100	03298	C4-1/8-T0-383R-F
A3R30	0757-0274	2	RESISTOR 1.21K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1213-F
A3R31	0698-7229	1	RESISTOR 511 1% .05W F TC=0+-100	03298	C3-1/8-T0-511R-G
A3R32	0683-1555	1	RESISTOR 1.5M 5% .25W FC TC=-900/+1100	01606	CB1555
A3R33	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A3R34	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A3R35	0757-0424	1	RESISTOR 1.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1101-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R36	2100-2574	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	0365A	ET50X501
A3R37	2100-2413	2	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	0365A	ET50X201
A3R38†	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A3R39	0698-4055	2	RESISTOR 1K .25% .125W F TC=0+-100	03888	PME55-1/8-T0-1001-C
A3R40	0698-0082	1	RESISTOR 464 1% .125W F TC=0+-100	03298	C4-1/8-T0-4640-F
A3R41	0698-4055		RESISTOR 1K .25% .125W F TC=0+-100	03888	PME55-1/8-T0-1001-C
A3R42	0757-0278	8	RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A3R43	0757-0180	2	RESISTOR 31.6 1% .125W F TC=0+-100	01606	CC
A3R44	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A3R45	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A3R46	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A3U1	1826-0089	1	IC 2525 OP AMP	0379I	HA2-2525-5
A3U2	1820-0398	1	IC 72710 COMPARATOR	02230	710PC
A3VR1	1902-3103	2	DIODE-ZNR 13.3V 5% DO-7 PD=.4W TC=+.059%	02230	FZ7272
A3VR2	1902-3059	2	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	02030	BZ 10939-62
			A3 MISCELLANEOUS		
	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	1480-0073		PIN:DRIVE 0.250" LG	0000J	OBD
	4040-0748		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0751	1	EXTRACTOR-PC BOARD ORN POLYC	28480	4040-0751
A4	86632-60005	1	BOARD ASSY, LEVEL AMPLIFIER	28480	86632-60005
A4C1	0160-2204	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA0+70	28480	0160-2204
A4C2	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A4C3	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A4C4	0180-0058	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	0420J	30D506G025CC2
A4C5	0160-0168	1	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	0420J	292P10492
A4C6	0180-2215	4	CAPACITOR-FXD 170UF+75-10% 15VDC AL	0420J	30D177G015DD2
A4C7	0180-1743	1	CAPACITOR-FXD .1UF+-10% 35VDC TA	0420J	150D104X9035A2
A4C8	0180-0291	3	CAPACITOR-FXD 1UF+-10% 35VDC TA	0420J	150D105X9035A2
A4C9	0160-2150	3	CAPACITOR-FXD 33PF +-5% 300VDC	28480	0160-2150
A4C10	0160-2150		CAPACITOR-FXD 33PF +-5% 300VDC	28480	0160-2150
A4C11	0180-2215		CAPACITOR-FXD 170UF+75-10% 15VDC AL	0420J	30D177G015DD2
A4C12	0160-2453	1	CAPACITOR-FXD .22UF +-10% 80VDC POLYE	28480	0160-2453
A4C13	0180-0094	5	CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A4C14	0180-0229	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	0420J	150D336X9010B2
A4C15	0160-2150		CAPACITOR-FXD 33PF +-5% 300VDC	28480	0160-2150
A4C16	0140-0196	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA0+70	72136	DM15F151J0300WV1CR
A4C17	0180-0094		CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A4CR1	1901-0022	3	DIODE-STABISTOR 10V 250MA	28480	1901-0022
A4CR2	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A4CR3	1901-0022		DIODE-STABISTOR 10V 250MA	28480	1901-0022
A4CR4	1901-0025	2	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A4CR5	1901-0025		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A4CR6	1901-0047	4	DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A4CR7	1901-0047		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A4CR8	1901-0047		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A4CR9	1901-0047		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A4K1	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A4L1	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A4L2	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A4L3	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A4Q1	1853-0001	1	TRANSISTOR PNP SI TO-39 PD=600MW	28480	1853-0001
A4Q2	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
	1205-0011	1	HEAT SINK TO-5/TO-39-PKG	28480	1205-0011
A4Q3	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q4	1854-0404	11	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q8	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A4Q9	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q10	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4Q11	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4Q12	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A4R1	0757-0421	1	RESISTOR 825 1% .125W F TC=0+-100	03298	C4-1/8-T0-825R-F
A4R2	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A4R3	0757-0279	6	RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A4R4	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A4R5	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R6	0698-3136		RESISTOR 14.7K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1472-F
A4R7	0698-3156		RESISTOR 14.7K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1472-F
A4R8	0698-3161	2	RESISTOR 38.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3832-F
A4R9	0698-3152	4	RESISTOR 3.48K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3481-F
A4R10	0698-0084		RESISTOR 2.15K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2151-F
A4R11	0698-0084		RESISTOR 2.15K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2151-F
A4R12	0698-3152		RESISTOR 3.48K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3481-F
A4R13	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A4R14	1990-0322	1	RAYISTOR	28480	1990-0322
A4R15	0698-3155	4	RESISTOR 4.64K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4641-F
A4R16	0757-0419	1	RESISTOR 681 1% .125W F TC=0+-100	03298	C4-1/8-T0-681R-F
A4R17	0698-3152		RESISTOR 3.48K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3481-F
A4R18	0698-0084		RESISTOR 2.15K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2151-F
A4R19†	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A4R20	0757-0438	2	RESISTOR 5.11K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5111-F
A4R21	0757-0346	4	RESISTOR 10 1% .125W F TC=0+-100	03298	C4-1/8-T0-10R0-F
A4R22	0757-0467	2	RESISTOR 121K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1213-F
A4R23	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A4R24	0757-0274		RESISTOR 1.21K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1213-F
A4R25	0698-3430	1	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A4R26	0757-0400	1	RESISTOR 90.9 1% .125W F TC=0+-100	03298	C4-1/8-T0-90R9-F
A4R27	0757-0343		RESISTOR 10 1% .125W F TC=0+-100	03298	C4-1/8-T0-10R0-F
A4R28	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03298	C4-1/8-T0-10R0-F
A4R29	0757-0199	3	RESISTOR 21.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2152-F
A4R30	0698-0084		RESISTOR 2.15K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2151-F
A4R31	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A4R32	0698-4037		RESISTOR 46.4 1% .125W F TC=0+-100	03298	C4-1/8-T0-46R4-F
A4R33	0698-3454	2	RESISTOR 215K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2153-F
A4R34	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4641-F
A4R35	2100-1758	1	RESISTOR-TRMR 1K 5% WW SIDE-ADJ 1-TRN	03740	3345W-W50-102
A4R36	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4641-F
A4R37	0757-0465	1	RESISTOR 100K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1003-F
A4R38	0698-3452	1	RESISTOR 147K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1473-F
A4R39	0757-0467		RESISTOR 121K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1213-F
A4R40	0698-3154	5	RESISTOR 4.22K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4221-F
A4R41	0698-3454		RESISTOR 215K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2153-F
A4R42	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100	03298	C4-1/8-T0-8251-F
A4R43	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A4R44	0698-3160	3	RESISTOR 31.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3162-F
A4R45	2100-0942	1	RESISTOR-TRMR 50K 20% MG SIDE-ADJ 1-TRN	05161	156-4
A4R46*	0698-3228	1	RESISTOR 49.9K 1% .125W F TC=0+-100 *FACTORY SELECTED PART	03298	C4-1/8-T0-4992-F
A4R47	0698-3157	6	RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A4R48	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5111-F
A4R49	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A4U1	1820-0223	4	IC 301 OP AMP	03790	LM301A
A4U2	1820-0223		IC 301 OP AMP	03790	LM301A
A4VR1	1902-3139	3	DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	02230	FZ7252
A4VR2	1902-3149	1	DIODE-ZNR 9.09V 5% DO-7 PD=.4W TC=+.057%	02230	FZ7256
A4VR3	1902-3059		DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	02030	SZ 10939-62
			A4 MISCELLANEOUS		
	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	4040-0748		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0752	1	EXTRACTOR-PC BOARD YEL POLYC	28480	4040-0752
	1480-0073		PIN:DRIVE 0.250" LG	0000J	OBD
A5	86632-60009	1	BOARD ASSY, 400/1K OSCILLATOR	28480	86632-60009
A5C1	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C2	0180-0094		CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A5C3	0180-0094		CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A5C4	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A5C5	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	0420J	150D105X9035A2
A5C6	0160-2199	4	CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A5C7	0180-2206	1	CAPACITOR-FXD 60UF+-10% 6VDC TA	0420J	150D606X9006B2
A5C8	0180-2205	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	0420J	150D334X9035A2
A5C9	0160-0937	1	CAPACITOR-FXD 1000PF +-2% 300VDC	28480	0160-0937
A5C10	0160-2671	1	CAPACITOR-FXD .1UF +-5% 80VDC POLYE	0420J	292P1045R8
A5C11	0180-2215		CAPACITOR-FXD 170UF+75-10% 15VDC AL	0420J	30D177G015DD2
A5C12	0160-2226	1	CAPACITOR-FXD 2200PF +-5% 300VDC	28480	0160-2226
A5C13	0180-0291		CAPACITOR-FXD 1UF+-10% 35VDC TA	0420J	150D105X9035A2
A5C14	0180-1704	2	CAPACITOR-FXD 47UF+-10% 6VDC TA	0420J	150D476X9006B2
A5CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR9	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5K1	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A5K2	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A5L1	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A5L2	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A5Q1	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A5Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A5Q3	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A5R1	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5R2	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A5R3	0698-3152		RESISTOR 3.48K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3481-F
A5R4	0757-0418		RESISTOR 619 1% .125W F TC=0+-100	03298	C4-1/8-T0-619R-F
A5R5	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5R6	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5R7	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5R8	0757-0462	1	RESISTOR 75K 1% .125W F TC=0+-100	03298	C4-1/8-T0-7502-F
A5R9	0757-1094		RESISTOR 1.47K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1471-F
A5R10	0757-0439	1	RESISTOR 6.81K 1% .125W F TC=0+-100	03298	C4-1/8-T0-6811-F
A5R11	0757-0458	3	RESISTOR 51.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5112-F
A5R12	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5112-F
A5R13	0757-0288		RESISTOR 9.09K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-9091-F
A5R14	0698-3457	1	RESISTOR 316K 1% .125W F TC=0+-100	01600	CC
A5R15	2100-1761	2	RESISTOR-TRMR 10K 5% WW SIDE-ADJ 1-TRN	0374D	3345W-W50-103
A5R16	2100-1760	1	RESISTOR-TRMR 5K 5% WW SIDE-ADJ 1-TRN	0374D	3345W-W50-502
A5R17	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A5R18	0698-3159	1	RESISTOR 26.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2612-F
A5R19	0698-0083		RESISTOR 1.96K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1961-F
A5R20	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A5R21	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A5R22	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5R23	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A5U1	1820-0223		IC 301 OP AMP	0379D	LM301A
A5VR1	1902-0025	2	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	0223G	FZ7260
			A5 MISCELLANEOUS		
	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	1480-0073		PINDRIVE 0.250" LG	0000J	OBD
	4040-0748		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0753	1	EXTRACTOR-PC BOARD GRN POLYC	28480	4040-0753
A6	86632-60003	1	BOARD ASSY, FM ATTENUATOR	28480	86632-60003
A6C1	0160-2199		CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A6C2	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A6C3	0180-0374	7	CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X9020B2
A6C4	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X9020B2
A6C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C7	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C9	0180-2214	1	CAPACITOR-FXD 90UF+75-10% 16VDC AL	0420J	30D906G016CC2
A6C10	0160-0174	1	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A6C11	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X9020B2
A6C12			NOT ASSIGNED		
A6C13	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A6C14	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A6C15	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C16	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C17	0160-3455	11	CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A6C18	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A6C19	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A6C20	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C21	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C22	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C23	0180-2215		CAPACITOR-FXD 170UF+75-10% 15VDC AL	0420J	30D177G015DD2
A6C24	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A6C25	0180-0229		CAPACITOR-FXD 33UF+-10% 10VDC TA	0420J	150D336X9010B2
A6CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR8	1901-0450	3	DIODE-SWITCHING 50V 100MA 10NS DO-7	28480	1901-0450
A6CR9	1901-0450		DIODE-SWITCHING 50V 100MA 10NS DO-7	28480	1901-0450
A6CR10	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR13	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6J1	1250-1377	1	CONNECTOR-RF SMB FEM PC 50-OHM	0362A	700214
	2190-0326	1	WASHER-FL NM NO. 4 .119-IN-ID .188-IN-OD	28480	2190-0326
A6K1	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A6K2	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A6K3	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A6K4	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A6L1	9140-0158	1	COIL-MLD 1UH 10% Q=32 .095DX.25LG	02178	09-4426-6K
A6L2	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A6L3	9140-0114	6	COIL-MLD 10UH 10% Q=55 .155DX.375LG	02178	15-4445-2K
A6L4	9100-1629	2	COIL-MLD 47UH 5% Q=55 .155DX.375LG	02178	15-1315-4J
A6L5	9140-0144	14	COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	02178	09-4436-8K
A6L6	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	02178	09-4436-8K
A6L7	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	02178	09-4436-8K
A6L8	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	02178	09-4436-8K
A6L9	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	02178	15-4445-2K
A6L10	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	02178	15-4445-2K
A6L11	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	02178	15-4445-2K
A6Q1	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A6Q2	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q3	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A6Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q5	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q6	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6Q7	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A6R1	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A6R2	0698-3447	6	RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A6R3	0698-3155		RESISTOR 4.64K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4641-F
A6R4	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A6R5	0757-0458		RESISTOR 51.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5112-F
A6R6	0698-3161		RESISTOR 38.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3832-F
A6R7	0698-3153		RESISTOR 3.83K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3831-F
A6R8	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A6R9	0698-3440	2	RESISTOR 196 1% .125W F TC=0+-100	03298	C4-1/8-T0-196R-F
A6R10	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A6R11	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A6R12	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A6R13	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A6R14	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A6R15	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A6R16	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A6R17	0698-3136	2	RESISTOR 17.8K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1782-F
A6R18	0698-3136		RESISTOR 17.8K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1782-F
A6R19	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A6R20	2100-1761		RESISTOR-TRMR 10K 5% WW SIDE-ADJ 1-TRN	03740	3345W-W50-103
A6R21	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A6R22	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2152-F
A6R23	2100-1755	1	RESISTOR-TRMR 100 5% WW SIDE-ADJ 1-TRN	03740	3345W-W50-101
A6R24	0757-0290	2	RESISTOR 6.19K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-6191-F
A6R25	2100-1759	1	RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	03740	3345W-W50-202
A6R26	0757-0317		RESISTOR 1.33K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1331-F
A6R27	0698-3437		RESISTOR 133 1% .125W F TC=0+-100	03298	C4-1/8-T0-133R-F
A6R28	0698-3428	1	RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A6R29	0698-3132	1	RESISTOR 261 1% .125W F TC=0+-100	03298	C4-1/8-T0-2610-F
A6R30	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A6R31	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A6R32	0757-0379	1	RESISTOR 12.1 1% .125W F TC=0+-100 *FACTORY SELECTED PART	0299E	MF4C1/8-T0-12R1-F
A6R33	0698-3437		RESISTOR 133 1% .125W F TC=0+-100	03298	C4-1/8-T0-133R-F
A6R34	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A6R35	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A6R36	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A6R37	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3161-F
A6R38	0698-7212	2	RESISTOR 100 1% .05W F TC=0+-100	03298	C3-1/8-T0-100R-G
A6R39	0698-7212		RESISTOR 100 1% .05W F TC=0+-100	03298	C3-1/8-T0-100R-G

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6R40	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A6U1	1858-0008	1	TRANSISTOR ARRAY	02036	MHQ6001
A6U2	1820-0068	1	IC GATE TTL NAND TPL 3-INP	02236	7410PC
			A6 MISCELLANEOUS		
	0360-1514		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	1480-0073		PIN:DRIVE 0.250" LG	0000J	DBO
	4040-0748		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	4040-0754	1	EXTRACTOR-PC BOARD BLU POLYC	28480	4040-0754
A7	86635-60011	1	PANEL ASSY, REAR	28480	86635-60011
A7C1	0160-2437	8	CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C2	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C3	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C4	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C5	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C6	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C7	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C8	0160-2437		CAPACITOR-FDTHRU 5000PF +80 -20% 200V	28480	0160-2437
A7C9	0360-1749	3	FEED-THRU: 1 PF	28480	0360-1749
A7C10	0360-1749		FEED-THRU: 1 PF	28480	0360-1749
A7C11	0360-1749		FEED-THRU: 1 PF	28480	0360-1749
A7J1			NOT ASSIGNED		
A7J2	1250-0901	3	CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	0362A	700166
A7J3	1250-0901		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	0362A	700166
A7J4	1250-0901		CONNECTOR-RF SMB M SGL-HOLE-FR 50-OHM	0362A	700166
A7W1			NOT ASSIGNED		
A7W2	86632-60017	1	CABLE ASSY, REFERENCE SWITCH BOARD	28480	86632-60017
			A7 MISCELLANEOUS		
	3050-0380	6	WASHER-FL NM NO. 0000 .031-IN-ID	28480	3050-0380
	86632-00003	1	COVER, OSCILLATOR	28480	86632-00003
	86632-00004	1	COVER, MIXER	28480	86632-00004
	86632-20012	4	SPACER, COVER	28480	86632-20012
	86632-20013	1	HOUSING, REAR	28480	86632-20013
A7A1	86632-60008	1	BOARD ASSY, MIXER 20 MHZ	28480	86632-60008
A7A1C1	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	04203	150D106X902B2
A7A1C2			NOT ASSIGNED		
A7A1C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C7	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A1C9	0160-3456	9	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A7A1C10	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A7A1CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A1CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A1L1	9100-1626	2	COIL-MLD 36UH 5% Q=60 .155DX.375LG	28480	9100-1626
A7A1L2	9100-1626		COIL-MLD 36UH 5% Q=60 .155DX.375LG	28480	9100-1626
A7A1Q1	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A1Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A1Q3	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A1Q4	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A1R1	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4221-F
A7A1R2	0757-0200	6	RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A1R3	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R4	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R5	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R6	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A1R7	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4221-F
A7A1R8	0698-3438	1	RESISTOR 147 1% .125W F TC=0+-100	03298	C4-1/8-T0-147R-F
A7A1R9	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R10	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R11	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R12	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A1R13	2100-1788	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	62-205-1
A7A1T1	08552-6044	1	TRANSFORMER, RF, 5-PIN	28480	08552-6044
A7A2	86632-60001	1	BOARD ASSY, 20 MHZ SWITCH	28480	86632-60001

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7A2C1	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A2C2	0180-0197	2	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	0420J	150D225X9020A2
A7A2C3	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A2C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A2C5	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A2C6	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A7A2C7	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A7A2J1	1250-1255	1	CONNECTOR-RF SMB M PC 50-OHM	0576I	51-051-0000
A7A2K1	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A7A2K2	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A7A2K3	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A7A2K4	0490-1013		RELAY-REED 1C 250MA 28VAC 5VDC-COIL 3VA	28480	0490-1013
A7A2L1	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L2	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L3	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L4	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L5	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L6	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A2L7	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A7A3	86632-60002	1	BOARD ASSY, 20 MHZ VCO	28480	86632-60002
A7A3C1	0180-0197		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	0420J	150D225X9020A2
A7A3C2	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A7A3C3	0180-0228		CAPACITOR-FXD 22UF+-10% 15VDC TA	0420J	150D226X9015B2
A7A3C4	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C5	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A7A3C6	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C7	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A7A3C8	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C9	0160-2199		CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A7A3C10	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C11	0180-0094		CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A7A3C12	0150-0059	2	CAPACITOR-FXD 3.3PF +-.25PF 500VDC	28480	0150-0059
A7A3C13	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C14	0160-0945	1	CAPACITOR-FXD 910PF +-5% 100VDC MICA0+70	28480	0160-0945
A7A3C15	0160-2266	1	CAPACITOR-FXD 24PF +-5% 500VDC CER0+-30	28480	0160-2266
A7A3C16	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C17	0150-0059		CAPACITOR-FXD 3.3PF +-.25PF 500VDC	28480	0150-0059
A7A3C18	0160-2253	2	CAPACITOR-FXD 6.8PF +-.25PF 500VDC	28480	0160-2253
A7A3C19	0160-2253		CAPACITOR-FXD 6.8PF +-.25PF 500VDC	28480	0160-2253
A7A3C20	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C21	0160-2201	1	CAPACITOR-FXD 51PF +-5% 300VDC	28480	0160-2201
A7A3C22	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C23	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X9035B2
A7A3C24	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X9020B2
A7A3C25	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C26	0160-3536	2	CAPACITOR-FXD 620PF +-5% 100VDC MICA0+70	28480	0160-3536
A7A3C27	0160-3536		CAPACITOR-FXD 620PF +-5% 100VDC MICA0+70	28480	0160-3536
A7A3C28	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C29			NOT ASSIGNED		
A7A3C30			NOT ASSIGNED		
A7A3C31			NOT ASSIGNED		
A7A3C32	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7A3C33	0160-3184	1	CAPACITOR-FXD .47UF +-20% 50VDC	28480	0160-3184
A7A3CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR3	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR4	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR5	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR9†	0122-0065	1	DIODE-VVC 29PF/-3V 30MV,HYPERABRUPT	76101	
A7A3CR10			NSR, PART OF CR9		
A7A3CR11			NSR, PART OF CR9		
A7A3CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3CR13	1902-3104	2	DIODE-ZNR 5.62V 5% DO-7 PD=.4W TC=+.016%	0203G	SZ 10939-110
A7A3CR14	1902-3139		DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	0223G	FZ7252
A7A3CR15	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7A3K1	0490-0782	1	RELAY-REED 1A 100MA 250VAC 9VDC-COIL 3VA	28480	0490-0782
A7A3K2	0490-0916		RELAY-REED 1A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-0916
A7A3L1	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	0217B	15-4445-7J
A7A3L2	9100-1629		COIL-MLD 47UH 5% Q=55 .155DX.375LG	0217B	15-1315-4J
A7A3L3	9100-2816	1	COIL 1UH 5% Q=125 .3120X1.047LG	28480	9100-2816
A7A3L4	9140-0180	1	COIL-MLD 2.7UH 10% Q=33 .155DX.375LG	0217B	15-4425-11K
A7A3L5	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	0217B	15-4445-2K

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7A3L6	9140-0114		COIL-MLD 10UH 10% Q=55 .155DX.375LG	0217B	15-4445-2K
A7A3Q1	1855-0081	1	TRANSISTOR J-FET 2N5245 N-CHAN D-MODE SI	0169H	2N5245
A7A3Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A3Q3	1854-0345	1	TRANSISTOR NPN 2N3179 SI TO-72 PD=200MW	02030	2N5179
A7A3Q4	1853-0020		TRANSISTOR PNP SI PD=300MW FT=150MHZ	28480	1853-0020
A7A3Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A3Q6	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A3Q7	1855-0098	1	TRANSISTOR P-CHAN E-MODE TO-72 SI	28480	1855-0098
A7A3Q8	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A7A3R1	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A3R2	0757-0444	3	RESISTOR 12.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1212-F
A7A3R3	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	03298	C4-1/8-T0-511R-F
A7A3R4	0698-3160		RESISTOR 31.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3162-F
A7A3R5	0757-0444		RESISTOR 12.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1212-F
A7A3R6	0757-0444		RESISTOR 12.1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1212-F
A7A3R7	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A3R8	2100-1776	1	RESISTOR-TRMR 10K 5% WW TOP-ADJ 1-TRN	0374D	3349P-W50-103
A7A3R9	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-7501-F
A7A3R10	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A7A3R11	0698-3151	1	RESISTOR 2.87K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2871-F
A7A3R12	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A7A3R13	0698-3157		RESISTOR 19.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1962-F
A7A3R14	0757-0288		RESISTOR 9.09K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-9091-F
A7A3R15	0757-0199		RESISTOR 21.5K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2152-F
A7A3R16	0698-3440		RESISTOR 196 1% .125W F TC=0+-100	03298	C4-1/8-T0-196R-F
A7A3R17	0757-1094		RESISTOR 1.47K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1471-F
A7A3R18	0757-0398	1	RESISTOR 75 1% .125W F TC=0+-100	03298	C4-1/8-T0-75R0-F
A7A3R19	0757-0470	1	RESISTOR 162K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1623-F
A7A3R20	0683-7545	1	RESISTOR 750K 5% .25W FC TC=800/+900	01600	CB7545
A7A3R21	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A7A3R22	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A7A3R23	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A3R24	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4221-F
A7A3R25	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A7A3R26	0698-3154		RESISTOR 4.22K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4221-F
A7A3R27	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A7A3R28	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-5621-F
A7A3R29	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A7A3R30	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A3R31	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A3R32	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A3R33	0698-3444		RESISTOR 316 1% .125W F TC=0+-100	03298	C4-1/8-T0-316R-F
A7A3U1	1820-0223		IC 301 OP AMP	0379D	LM301A
A7A3VR1	1902-3193		DIODE-ZNR 13.3V 5% DO-7 PD=.4W TC=+.059%	02233	FZ7272
A7A3VR2	1902-3104		DIODE-ZNR 5.62V 5% DO-7 PD=.4W TC=+.016%	02033	8Z 10939-110
A7A3VR3	1902-3139		DIODE-ZNR 8.25V 5% DO-7 PD=.4W TC=+.053%	02233	FZ7252
			A7A3 MISCELLANEOUS		
	1251-1556	3	CONNECTOR SPRING SOCKET(USED WITH A7A3Q7)	28480	1251-1556
A8	86635-60006	1	BOARD ASSY, MOTHER	28480	86635-60006
A8C1	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C2	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A8C3	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A8C4	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C5	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A8C6	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A8C7	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C8	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C9	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C10	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C11	0160-3455		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A8C12	0160-3456		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A8C13	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C14	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C15	0160-2055		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8CR1	1910-0016	1	DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A8L1	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A8L2	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K
A8L3	9100-2259	1	COIL-MLD 1.5UH 10% Q=32 .095DX.25LG	0217B	09-4436-2K
A8L4	9140-0144		COIL-MLD 4.7UH 10% Q=45 .095DX.25LG	0217B	09-4436-8K

See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8R1	0698-7219	1	RESISTOR 196 1% .05W F TC=0+-100	03298	C3-1/8-T0-196R-G
A8R2	0698-7210	5	RESISTOR 82.5 1% .05W F TC=0+-100	03298	C3-1/8-T00-82R5-G
A8R3	0698-7214	5	RESISTOR 121 1% .05W F TC=0+-100	03298	C3-1/8-T0-121R-G
A8R4	0698-7210		RESISTOR 82.5 1% .05W F TC=0+-100	03298	C3-1/8-T00-82R5-G
A8R5	0698-7210		RESISTOR 82.5 1% .05W F TC=0+-100	03298	C3-1/8-T00-82R5-G
A8R6	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	03298	C3-1/8-T0-121R-G
A8R7	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	03298	C3-1/8-T0-121R-G
A8R8	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	03298	C3-1/8-T0-121R-G
A8R9	0698-7214		RESISTOR 121 1% .05W F TC=0+-100	03298	C3-1/8-T0-121R-G
A8R10	0698-7210		RESISTOR 82.5 1% .05W F TC=0+-100	03298	C3-1/8-T00-82R5-G
A8R11	0698-7210		RESISTOR 82.5 1% .05W F TC=0+-100	03298	C3-1/8-T00-82R5-G
A8XA1			NOT ASSIGNED		
A8XA2	1251-2026	1	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	04500	252-18-30-300
A8XA3	1251-2035	4	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	04500	252-15-30-300
A8XA4	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	04500	252-15-30-300
A8XA5	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	04500	252-15-30-300
A8XA6	1251-2035		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	04500	252-15-30-300
A8XA7			NOT ASSIGNED		
A8XA8			NOT ASSIGNED		
A8XA9	1251-2034	1	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	04500	252-10-30-300
A9	86635-60001	1	BOARD ASSY, DEVIATION DETECTOR	28480	86635-60001
A9C1	0160-4084		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-4084
A9C2	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X902B2
A9C3	0180-0374		CAPACITOR-FXD 10UF+-10% 20VDC TA	0420J	150D106X902B2
A9C4	0160-2199		CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A9C5	0180-0116		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	0420J	150D685X903S2
A9C6	0180-1746	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	0420J	150D156X902B2
A9C7	0180-1704		CAPACITOR-FXD 47UF+-10% 6VDC TA	0420J	150D476X900B2
A9C8 †	0160-2205	1	CAPACITOR-FXD 120PF +-5% 300VDC MICA 0+70	28480	0160-2205
A9CR1	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR2	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9L1	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A9L2	9140-0179		COIL-MLD 22UH 10% Q=75 .155DX.375LG	02178	15-4445-7J
A9Q1	1853-0007	1	TRANSISTOR PNP 2N3251 SI TO-18 PD=360MW	02030	2N3251
A9Q2	1853-0012	1	TRANSISTOR PNP 2N2904A SI TO-39 PD=600MW	0169H	2N2904A
A9R1	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A9R2	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A9R3	0757-0418		RESISTOR 619 1% .125W F TC=0+-100	03298	C4-1/8-T0-619R-F
A9R4	0757-0290		RESISTOR 6.19K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-6191-F
A9R5	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	03298	C4-1/8-T0-422R-F
A9R6	0757-0418		RESISTOR 619 1% .125W F TC=0+-100	03298	C4-1/8-T0-619R-F
A9R7	0757-0428	1	RESISTOR 1.62K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1621-F
A9R8	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A9R9 †	0698-3637	1	RESISTOR 820 5% 2W MO TC=0+-200	0341B	FP-42
A9R10 †	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	03298	C4-1/8-T0-101-F
A9R11	0757-0180		RESISTOR 31.6 1% .125W F TC=0+-100	0160G	CC
A9R12	2100-2413		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	0365A	ET50X201
A9R13	0757-0278		RESISTOR 1.78K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1781-F
A9R14	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	03298	C4-1/8-T0-10R0-F
A9R15	0757-1094		RESISTOR 1.47K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1471-F
A9R16	0698-3160		RESISTOR 31.6K 1% .125W F TC=0+-100	03298	C4-1/8-T0-3162-F
A9R17 †	0698-3442	1	RESISTOR 237 1% .125W F TC=0+-100	03298	C4-1/8-T0-237R-F
A9U1	1820-0704	1	IC MV TTL MONOSTBL RETRIG	0169H	SN74122N
A9U2	1820-0535		IC DRVR TTL AND DUAL 2-INP	0340F	LM75451AN
A9U3	1826-0013	1	IC 741 OP AMP	0218J	888741CJ
A9U4	1826-0081	1	IC 318 OP AMP	0379D	LM318
A9VR1	1902-0025		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	02233	FZ7260
			A9 MISCELLANEOUS		
	0360-0124	1	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-0124
	4040-0748		EXTRACTOR-PC BOARD BLK POLYC	28480	4040-0748
	1480-0073		PIN:DRIVE 0.250" LG	0000J	OBD
	4040-0756	1	EXTRACTOR-PC BOARD WHT POLYC	28480	4040-0756
			CHASSIS PARTS		
DS1	2140-0356	2	LAMP-INCAND 7683 5VDC 60MA T-1-BULB	28480	2140-0356
DS2	2140-0356		LAMP-INCAND 7683 5VDC 60MA T-1-BULB	28480	2140-0356

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-1.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
DS3	2140-0092	1	LAMP-INCAND 665 5VDC 60MA T-1-BULB	28480	2140-0092
J1	1250-0913	1	CONNECTOR-RF BNC FEM SPCL-MTG 50-OHM	28480	1250-0913
M1	1120-0559	1	METER,	28480	1120-0559
P5	86635-60009	1	CONNECTOR ASSY, REAR (INCLUDES W1,W2,W3)	28480	86635-60009
	1251-3087	16	CONTACT-CONN U/W-RECT FEM CRP	05008	100-09088
	5040-0381	1	CONNECTOR FACE, 42-PIN	28480	5040-0381
	5040-0380	1	CONNECTOR, 42-PIN	28480	5040-0380
PSW1	86632-60014	1	CABLE ASSY, 20 MHZ INPUT , INCLUDES:	28480	86632-60014
	1251-0546	3	CONTACTSR & P CONNECTOR, RECTANGULAR	81318	III170548
	1250-0885	2	CONNECTOR-RF SMB FEM UNMTD 50-OHM	0362A	700405
PSW2	86635-60010	1	CABLE ASSY, PHASE MODULATION OUTPUT	28480	86635-60010
	1251-0546		CONTACTSR & P CONNECTOR, RECTANGULAR	81318	III170548
PSW3	86632-60019	1	CABLE ASSY, 20 MHZ OUTPUT , INCLUDES:	28480	86632-60019
	1251-0546		CONTACTSR & P CONNECTOR, RECTANGULAR	81318	III170548
	1250-0885		CONNECTOR-RF SMB FEM UNMTD 50-OHM	0362A	700405
R1	2100-2728	1	RESISTOR-VAR CONTROL C 1K 20% LIN	28480	2100-2728
S1	3101-0044	1	SWITCH-PB SPST-NO MOM .1A 115VAC	0499J	39-1 N.O.
W1			PART OF P5		
W2			PART OF P5		
W3			PART OF P5		
W4	86635-60012	1	CABLE ASSY, FM MODULATION INCLUDES	28480	86635-60012
	1250-0872	2	CONNECTOR-RF SMB FEM UNMTD 50-OHM	0331F	32P101-1
			MISCELLANEOUS PARTS		
	0370-1091	1	KNOB-BASE 1/2 JGK .25-IN-ID (MODULATION LEVEL)	28480	0370-1091
	0370-2499	1	KNOB-BASE-SKT 1/2 JGK .25-IN-ID (SOURCE)	28480	0370-2499
	0370-2617	1	KNOB-BASE-SKT 1/2 JGK .25-IN-ID (MODE)	28480	0370-2617
	0510-0729	1	RETAINER-PUSH ON CIRC EXT .203-DIA	02768	8063-20-01-2414
	1450-0153	1	LAMPHOLDER MDGT-SC-FLG-SKT TUR-TERM	08717	1028-R BODY
	1450-0371	1	LENS CAP AMB-TL .219-DIA 12-40 THD	08717	102-A-STD LENS
	1450-0394	2	LAMPHOLDER DC-SKT SLDR-LUG-TERM	0450D	CM 21-1
	86601-00013	1	LATCH	28480	86601-00013
	86601-20019	1	STUD LATCH	28480	86601-20019
	86601-20020	1	WASHER LATCH	28480	86601-20020
	86601-40018	1	SCREW, METER ADJUST	28480	86601-40018
	86632-00013	2	COVER, HALF	28480	86632-00013
	86632-20023	1	PANEL, SUB	28480	86632-20023
	86634-00005	1	METER MOUNT	28480	86634-00005
	86634-00009	2	BRACKET, LAMPHOLDER	28480	86634-00009
	86634-20008	1	HOUSING, FRONT	28480	86634-20008
	86635-00001	1	PANEL, FRONT	28480	86635-00001
	86635-00002	1	FRAME, RIGHT	28480	86635-00002
	86635-00003	1	FRAME, LEFT	28480	86635-00003
	86635-20012	1	WINDOW, PLUG-IN	28480	86635-20012
	86635-60007	1	WIRING HARNESS, FRONT	28480	86635-60007

See introduction to this section for ordering information

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.	
0160G	ALLEN-BRADLEY CO	MILWAUKEE WI	
0169M	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	
02768	ILLINOIS TOOL WORKS INC FASTEX DIV	DES PLAINES IL	60016
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
0203G	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	
02178	AIRCO SPEER ELEK DIV AIR RDCN CO	NOGALES AZ	
0218J	PRECISION MONOLITHICS INC	SANTA CLARA CA	
06776	ROBINSON NUGENT INC	NEW ALBANY IN	47150
0223G	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	
08717	SLOAN CO THE	SUN VALLEY CA	91352
0299E	MEPCO/ELECTRA CORP	MINERAL WELLS TX	
03298	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	
0331F	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	
0340F	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	
03418	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	
28480	HP DIV 00 CORPORATE	PALO ALTO CA	
0362A	CABLEWAVE SYSTEMS INC	NORTH HAVEN CT	
0365A	MEPCO/ELECTRA CORP	SAN DIEGO CA	
0374D	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	
0379D	ADVANCED MICRO DEVICES INC	SUNNYVALE CA	
0379I	HARRIS SEMICON DIV HARRIS-INTERTYPE	MELBOURNE FL	
0420J	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	
0450D	CHICAGO MINIATURE/DRAKE	CHICAGO IL	
0450G	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VLGE IL	
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
76101	MAICO HEARING INSTRUMENTS	MINNEAPOLIS MN	55435
0499J	GRAYHILL INC	LA GRANGE IL	
05008	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	
0516J	TRW INC ST PETERSBURG DIV	ST PETERSBURG FL	
05761	SEALECTRO CORP	MAMARONECK NY	

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to instruments for which the content does not apply directly.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

7-5. If your instrument serial number is not listed on the title page of this manual or in Table 7-1 below, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
1417A00101 to 00110	E, D, C, B, A
1417A00111 to 00140	E, D, C, B
1535A	E, D, C
1605A	E, D
1638A	E

7-6. MANUAL CHANGE INSTRUCTIONS

CHANGE A

Table 6-2 and Service Sheet 5:
Change A3R38 to 0757-0280 RESISTOR 1K 1% .125W F TC=0±100.

Table 6-2 and Service Sheet 8:
Delete A9C8 0160-2205 CAPACITOR-FXD 120 PF ±5% 300 WVDC MICA.
Delete A9R17 0698-3443 RESISTOR 237 OHM 1% .125 W F TC=0±100.
Change A9R9 0757-0819 RESISTOR 909 OHM 1% .5W F TUBULAR.
Change A9R10 0698-3442 RESISTOR 237 OHM 1% .125W F TUBULAR.

CHANGE B

Table 6-2:
Change A7A3CR9, CR10 and CR11 to 0122-0053 DIODE VOLT VAR MATCHED SET OF 3.

NOTE

These parts are not the recommended replacement.

CHANGE C

Table 6-2 and Service Sheet 5:
Change A3 to 86635-60005.

Service Sheet 5:
Change A3K10 pin 4 connection from +5.25VF to ground.

MANUAL CHANGES (Cont'd)

CHANGE D

Table 6-2 and Service Sheet 5:
Change A3R26 to 0757-0280 RESISTOR 1K 1% .125W F TC=0±100.

CHANGE E

Table 6-2 and Service Sheet 4:
Change A4R19 to 0757-0416 RESISTOR 511 OHM 1% .125W F TC =0±100.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information for the Modulation Section plug-in. Circuit operation and troubleshooting information is provided. Personnel safety considerations are also described.

8-3. The service sheets normally include principles of operation and troubleshooting information, a component location diagram, and a schematic, all of which apply to a specific portion of circuitry within the instrument.

8-4. Information related to operation of the Modulation Section plug-in as part of the 8660-series Synthesized Signal Generator System is provided prior to Service Sheet 1.

8-5. Service Sheet 1 includes an overview of Modulation Section operation, troubleshooting on an assembly or stage level, and a troubleshooting block diagram. The block diagram serves as an index for the remaining service sheets.

8-6. The Schematic Diagram Notes, Figure 8-1, aid in interpreting the schematics.

8-7. The last foldout in the manual includes a table which cross-references all pictorial and schematic locations of each assembly, chassis mounted component, and adjustable component. The figure is a pictorial representation of the Modulation Section and shows location of the aforementioned parts.

8-8. SAFETY CONSIDERATIONS

8-9. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition (see Sections II, III, and V). Service and adjustments should be performed only by qualified service personnel.

8-10. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

8-11. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNING

The service information is often used with power supplied and protective covers removed from the instrument. Energey available at many points may constitute a shock hazard.

8-12. PRINCIPLES OF OPERATION

8-13. The Principles of System Operation explains how the Modulation Section operates within the Synthesized Signal Generator System, i.e., how other sections affect the Modulation Section and in turn how they are affected by the Modulation Section. Control functions in both local and remote modes are also explained. A systems block diagram is included.

8-14. Overall operation of the Modulation Section is discussed in Service Sheet 1. The remaining service sheets are concerned only with sections and/or circuit assemblies within the Modulation Section plug-in.

8-15. TROUBLESHOOTING

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660 series mainframe Operating and Service manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information does not isolate the problem to an instrument, proceed to the Systems Troubleshooting information in Service Sheet 1 of the RF Section Manual. This information may be used to isolate the defect to the Modulation Section, another plug-in, or the mainframe. If the problem is in this plug-in, turn to Service Sheet 1 for further troubleshooting information.

8-16. System Troubleshooting

8-17. The System Troubleshooting information in Section VIII of the HP 8660-series mainframe manual should be used when first attempting to isolate a circuit defect. If the defect cannot be isolated to an individual instrument in the system, the technician is normally directed to the System Troubleshooting in the RF Section manual. The problem may then be isolated to the RF Section, Modulation Section, Frequency Extension Module, or the mainframe.

8-18. Modulation Section Troubleshooting

8-19. When the defect has been isolated to the Modulation Section, refer to Service Sheet 1. This information is used to isolate the problem to a section or assembly.

8-20. Troubleshooting Aids

8-21. Circuit Board Aids. Test points are physically located on the circuit boards as metal posts or circuit pads and usually have wither a reference designator (such as TP1) or a label which relates to the function (AM, Pulse, ID, etc.). Transistor emitters, diode cathodes, the positive lead of electrolytic capacitors, and pin 1 of integrated circuits may be indicated by an E, a diode symbol, +, and a tear-drop shaped pad respectively. Also, a square circuit pad (as opposed to a round pad) may be used in place of any of the previously mentioned symbols.

8-22. Service Sheet Aids. RF levels, ac voltages, waveforms, and dc voltages are often shown on schematic diagrams. Integrated circuit connection diagrams plus diagrams of relays and printed circuit connectors help to locate specific inputs and outputs. Notes are used to explain certain circuits or mechanical configurations not easily shown on the schematic.

8-23. The locations of individual components mounted on printed circuit boards are found on individual service sheets on the pictorial representation of the circuit boards. Chassis mounted parts, major assemblies, and adjustable components locations are found on the last foldout in this manual.

8-24. Figure 8-1, Schematic Diagram Notes, provides information relative to symbols and values shown on the schematic diagrams.

8-25. Service Kit and Extender Boards. The HP 11672A Service Kit contains interconnect cables, RF cables, various coaxial adapters, and an adjustment tool, all of which are useful in servicing the Modulation Section plug-in. Refer to the HP 11672A Operating Note for a listing and pictorial representation of the contents. A list of the service kit contents is also found in the test equipment and accessories list in Section I of the mainframe manual.

8-26. Circuit board extenders are provided, with the mainframe. These extender boards enable the technician to provide easy access to components and test points. Refer to the list found under Accessories Supplied in Section I of the mainframe manual.

8-27. RECOMMENDED TEST EQUIPMENT

8-28. Table 1-2 lists the test equipment and accessories recommended for use in servicing the instrument. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

8-29. REPAIR

8-30. General Disassembly Procedures

8-31. Procedures for removing the Modulation Section plug-in from the mainframe and the plug-in covers are found on the left-hand foldout page immediately preceding the last foldout in the manual. Front and rear panel disassembly procedures explaining how to gain access to the internal assemblies are also provided.

8-32. The machine screws used throughout the plug-in have a Pozidriv head. Pozidriv is very similar in appearance to the Phillips head, but using a Phillips screwdriver may damage the Pozidriv screw head.

8-33. Post Repair Adjustments

8-34. After a defective circuit is repaired, refer to Section V and perform the adjustment procedure(s) for circuits whicy may be affected by the change. Consider the instructions under paragraphs entitled Related Adjustments and Post Adjustment Tests.

8-35. PRINCIPLES OF SYSTEMS OPERATION

8-36. The Modulation Section controls the CW, phase, and frequency modulation modes of the signal generator system (refer to Figure 8-3). The modulation drive signal originates in an internal

SCHEMATIC DIAGRAM NOTES

Inductance is in microhenries, resistance is in ohms and capacitance is in microfarads unless otherwise noted.

* Asterisk denotes a factory-selected value. Value shown is typical . Part may be omitted. See Table 5-1.

Screwdriver Adjustment

Panel Control

Encloses Front Panel designations

Encloses Rear Panel designations

Circuit assembly border line.

Other assembly border line.

Wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example: (947) denotes white base, yellow wide stripe, violet narrow stripe.

K6 Indicates an output from a schematic that goes to an input identified as K on Service Sheet 6.

2A Indicates an input to a schematic that comes from an output identified as A on Service Sheet 2.

Indicates circuit ground.

Numbers in stars on circuit assemblies show locations of test points with a measurement aid (metal post, circuit pad, etc.) provided.

Letters in stars on circuit assemblies show locations of test points with no measurement aid provided.

Optically coupled isolator (light sensitive resistor).

1 On-page connector. This point is connected to another point on this page with the symbol 1.

Relays are shown in the unenergized position. Arrow indicates direction of armature travel.

Figure 8-1. Schematic Diagram Notes (1 of 3)

SCHEMATIC DIAGRAM NOTES

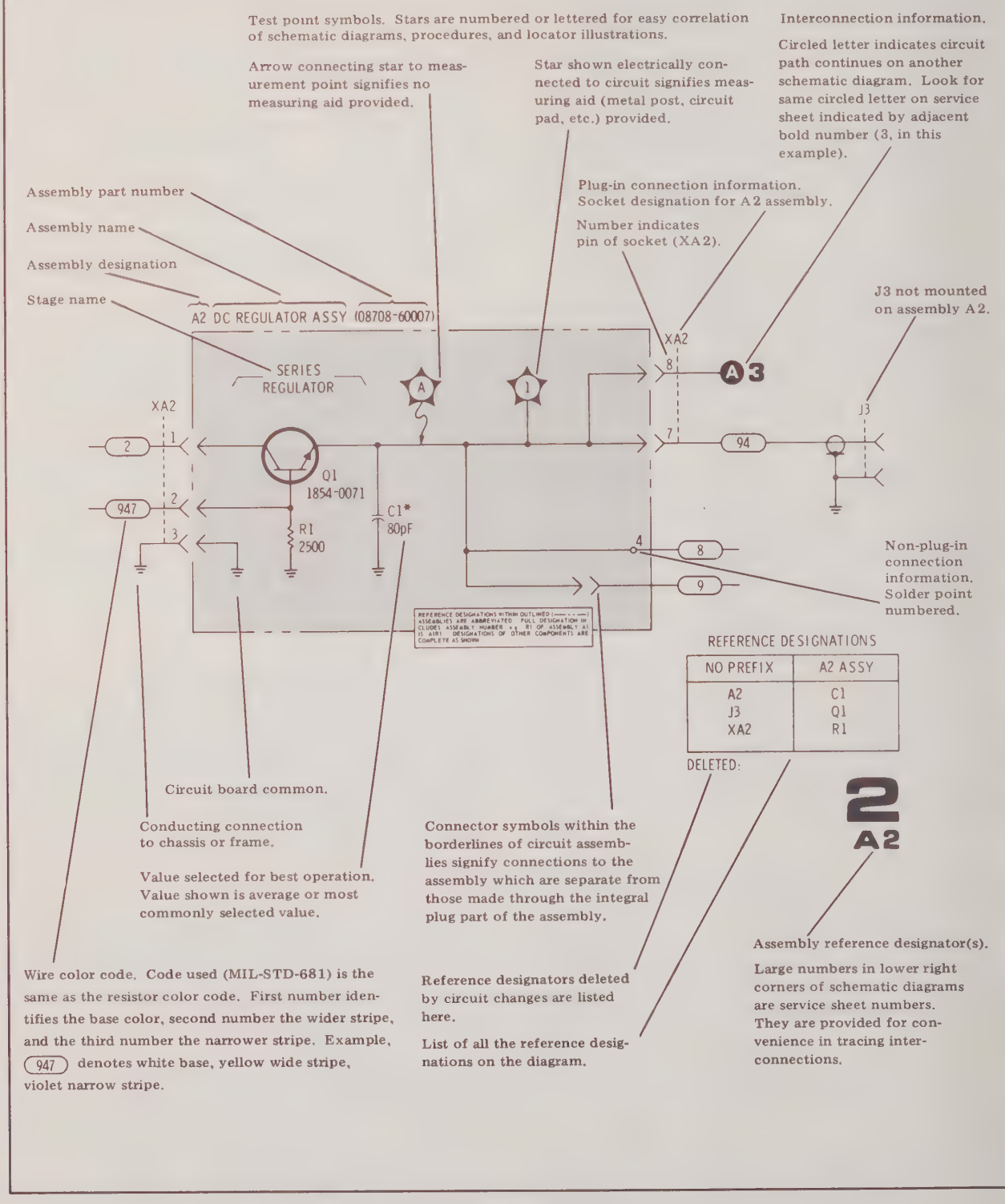

Test point symbols. Stars are numbered or lettered for easy correlation of schematic diagrams, procedures, and locator illustrations.
Arrow connecting star to measurement point signifies no measuring aid provided.
Star shown electrically connected to circuit signifies measuring aid (metal post, circuit pad, etc.) provided.
Interconnection information.
Circled letter indicates circuit path continues on another schematic diagram. Look for same circled letter on service sheet indicated by adjacent bold number (3, in this example).
Assembly part number
Assembly name
Assembly designation
Stage name
A2 DC REGULATOR ASSY (08708-60007)
SERIES REGULATOR
Plug-in connection information. Socket designation for A2 assembly.
Number indicates pin of socket (XA2).
J3 not mounted on assembly A2.
XA2
J3
Q1
1854-0071
R1
2500
C1*
80pF
947
94
8
9
Non-plug-in connection information. Solder point numbered.
REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN
REFERENCE DESIGNATIONS
NO PREFIX: A2, J3, XA2
A2 ASSY: C1, Q1, R1
DELETED:
Circuit board common.
Conducting connection to chassis or frame.
Value selected for best operation. Value shown is average or most commonly selected value.
Connector symbols within the borderlines of circuit assemblies signify connections to the assembly which are separate from those made through the integral plug part of the assembly.
Assembly reference designator(s).
Large numbers in lower right corners of schematic diagrams are service sheet numbers. They are provided for convenience in tracing interconnections.
Wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example, (947) denotes white base, yellow wide stripe, violet narrow stripe.
Reference designators deleted by circuit changes are listed here.
List of all the reference designations on the diagram.

Figure 8-1. Schematic Diagram Notes (2 of 3)

SCHEMATIC DIAGRAM NOTES

EXAMPLE: A3S1AR(2-1/2)

A3S1 = SWITCH S1 WITHIN ASSEMBLY A3

A = 1st WAFER FROM FRONT (A = 1st, ETC)

R = REAR OF WAFER (F = FRONT)

(2-1/2) = TERMINAL LOCATION (2-1/2) (VIEWED FROM FRONT)

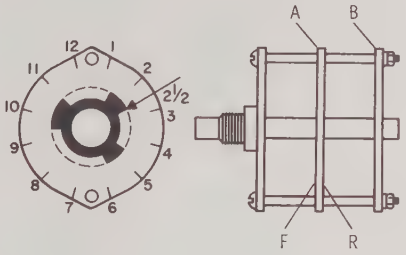


Figure 8-1. Schematic Diagram Notes (3 of 3)

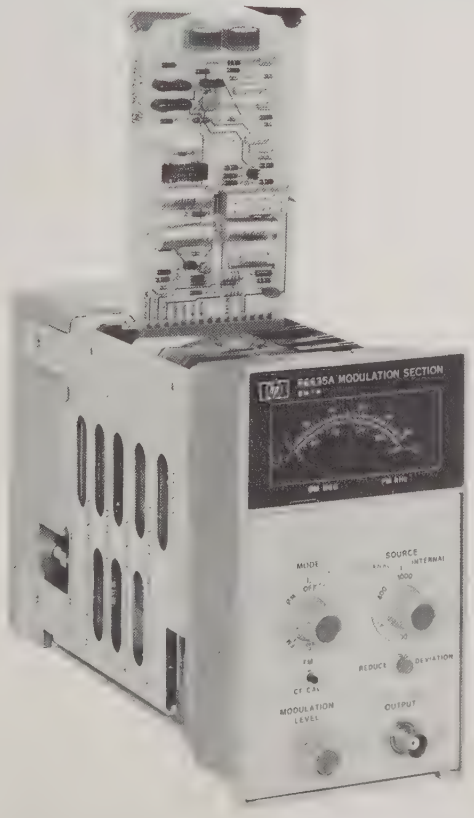


Figure 8-2. Circuit Board Extended for Troubleshooting

PRINCIPLES OF SYSTEMS OPERATION (Cont'd)

oscillator (400 or 1000 Hz), or in an external source. The external modulation drive signal is coupled into the system through the front panel jack. The modulation level is normally controlled from the front panel veriner. In the ϕM mode, the modulation signal is routed directly to the RF Section of the system. In the FM mode, the modulation signal modulates the 20 MHz voltage controlled oscillator (VCO).

8-37. RF Signal Flow

8-38. A 20 MHz reference signal from the system mainframe is connected to the Modulation Section. In the OFF (CW) and ϕM modes the reference signal is simply passed through the Modulation Section and on into the RF Section. In the FM mode, the 20 MHz VCO output is connected to the RF Section; the system's RF output is not phase-locked. The output is momentarily phase-locked to the 20 MHz reference by depressing the front panel FM CF CAL switch. The purpose of the FM CF CAL cycle is to reduce the frequency drift of the 20 MHz VCO to a minimum.

8-39. Remote Operation

8-40. In the remote mode, the LCL/RMT digital control input is low. This enables the storage registers to accept data being transmitted to the Modulation Section. The storage register selection circuit in the mainframe causes an address (in the form of a clock pulse train) to be transmitted synchronously with the programmed data. In this way selection of the mode and source is transmitted from an external programming source (such as a calculator or computer) through the mainframe DCU to one of the storage registers. Modulation level data is transmitted to the other register. The stored information is coupled to digital circuitry which selects the mode and source functions and modulation level.

8-41. Local Operation

8-42. In the local mode, the LCL/RMT digital control input is high. The MODE and SOURCE front panel switches are enabled and provide inputs to the digital control circuits in place of the storage registers. The analog Modulation Level control is used in place of the remote modulation level control circuits.

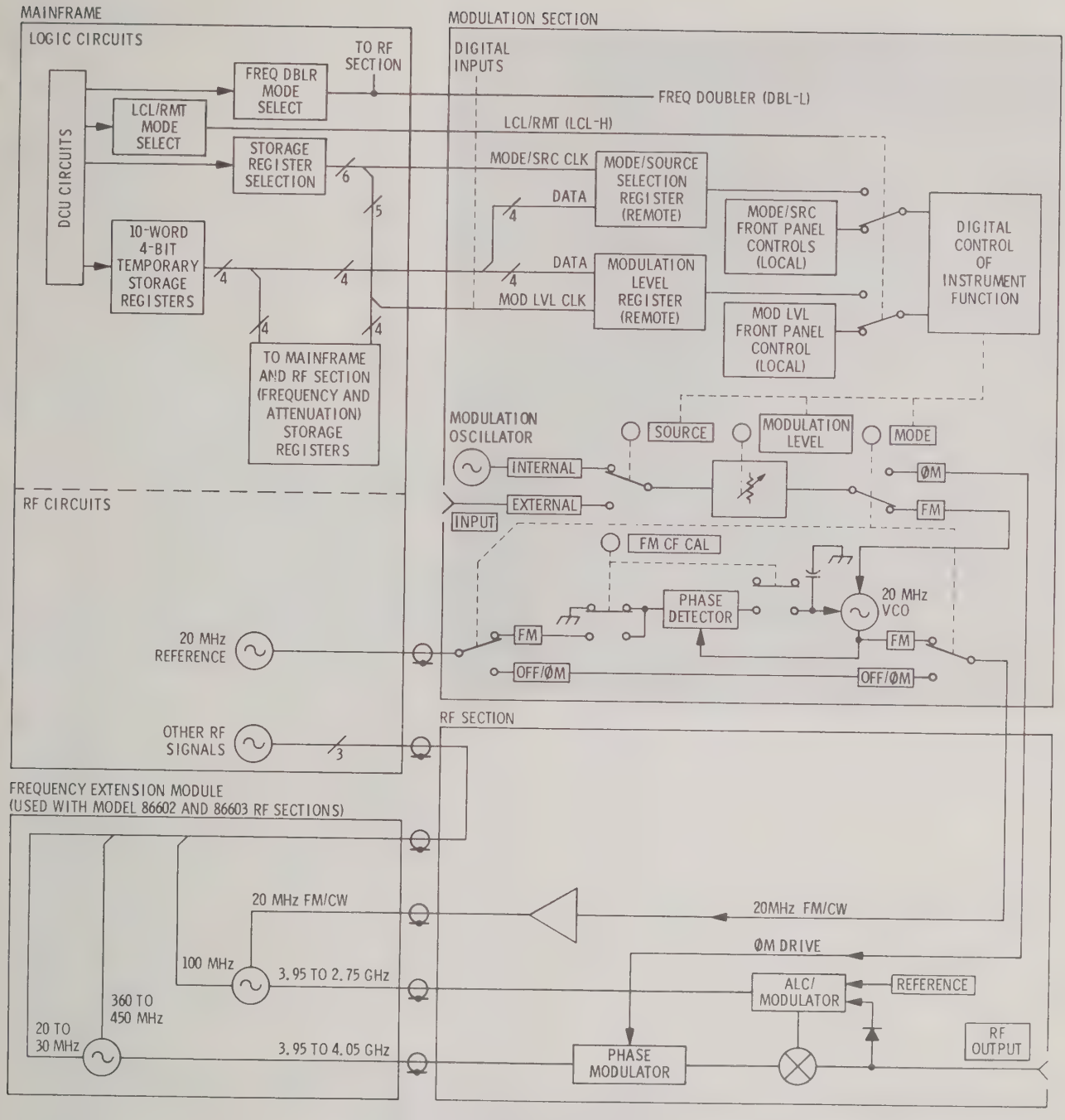


Figure 8-3. System Block Diagram

SERVICE SHEET 1

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting. If this indicates trouble in the Model 86635A Modulation Section, refer to this Service Sheet for overall troubleshooting procedures. Service Sheet 1 is keyed to all other Service Sheets.

TROUBLESHOOTING BLOCK DIAGRAM

A composite of all printed circuit board assemblies is shown in block diagram form on this Service Sheet. Use the block diagram and troubleshooting procedures following the principles of operation to isolate a trouble to a specific assembly. Then turn to the Service Sheet for that assembly and isolate the trouble to a specific component.

The large numbers in the lower right corner of each of the major blocks identify the Service Sheet which provides schematics and principles of operation for that particular assembly.

PRINCIPLES OF OPERATION

General

The Hewlett-Packard Model 86635A Modulation Section is a plug-in unit designed to provide either ϕM (Phase Modulation) or FM (Frequency Modulation) for the 8660 Synthesized Signal Generator System. The modulation signal may be from an external source or from an internal 400 Hz or 1000 Hz oscillator. The phase or frequency deviation is adjustable and the level is indicated on a meter. All front panel functions are remotely programmable through the mainframe.

The input to the Remote Attenuation Assembly must be held at a constant level without a dc offset voltage to ensure full VERNIER range control and calibrated system modulation level. For this reason, the internal modulation oscillator output and EXTERNAL AC input are coupled to the leveling amplifier input. The leveling amplifier is ac coupled and corrects for variations in input level within the specified range.

In the EXTERNAL DC mode, the external input is connected directly to the Remove Attenuation Assembly. Inputs without dc offset produce a calibrated meter reading and may be adjusted at the external source or the VERNIER control. A dc offset always produces erroneous modulation level meter reading and in the FM mode causes frequency offset in the A7A3 VCO (voltage controlled oscillator) and subsequently in the system center frequency.

In the FM mode, the 20 MHz VCO output is coupled to the RF Section in place of the 20 MHz reference signal. Because the VCO is not phase locked, over a period of time some frequency drift occurs. The error frequency may be compensated for at any time by pressing the front panel FM CF CAL switch or programming the FM CF CAL address.

During the resulting timed sequence, relays which control the events of center frequency calibration are switched at certain intervals. First the frequency modulation signal to the VCO is removed, then the VCO is phase locked to the 20 MHz reference signal, a flag is sent to the mainframe which inhibits the systems reception of programmed information, and a voltage is stored which holds the VCO frequency at 20 MHz.

The Frequency Doubler logic inputs from the mainframe control the indication of meter range and either doubles or halves the amplitude of the frequency and phase modulation drive signal to the RF Section. This is dependent on the system center frequency being above or below 1300 MHz.

A1 Front Harness Assembly

The frequency doubler logic input from the mainframe causes the lamp indicating the 0—100 range to be illuminated at center frequencies <1300 MHz. The lamp indicating the 0—200 range is illuminated at center frequencies $\geqslant 1300$ MHz.

A2 Switch Logic Assembly (Service Sheet 2)

Circuits on this assembly select either front panel control or programmed control from the mainframe. One register stores the coded data from modulation signal source, one register stores modulation mode data and two registers stores modulation level data. Logic circuits then provide decoding and interface to the other assemblies.

A5 Modulation Oscillator Assembly (Service Sheet 3)

This oscillator is the internal modulation source for either 400 Hz or 1000 Hz. An output amplifier

SERVICE SHEET 1 (Cont'd)

provides isolation to a front panel connector. For an external modulation source, the internal oscillator is turned off and the front panel jack becomes the input connection.

A4 Leveling Amplifier Assembly (Service Sheet 4)

The output of the leveling amplifier is maintained at a constant amplitude with an input from the modulation oscillator. In external AC LEVELED mode, the leveling amplifier output signal will also be leveled if the input is within the specified limits of frequency and amplitude. The output level is held constant by a negative feedback loop. The leveling amplifier is not used in the external DC mode.

A3 Remote Attenuation Assembly (Service Sheet 5)

The A3 assembly determines the modulation level for phase or frequency modulation. Relay switching sends the output either to the RF Section in the ϕM mode or to the A6 assembly in the FM mode. In the remote mode, the modulation level may be programmed in 100 steps by eight relays and a network of resistive attenuators.

In the local mode, the modulation level is controlled by the front panel MODULATION LEVEL control.

During the FM CF CAL sequence, the modulation signal is removed from the VCO by grounding the input to the remote attenuation circuits.

At center frequencies $\geqslant$1300 MHz, the frequency doubler logic input causes the gain of the input amplifier to be reduced by one-half.

A6 FM Attenuator Assembly (Service Sheet 6)

The A6 assembly provides relay switching which provides for better metering resolution with small FM deviations.

The monostable multivibrator is triggered to begin the FM center frequency calibration sequence. Due to delay elements introduced into the associated voltage translation circuits, the control voltages are present in a specific timed sequence. After the multivibrator has remained in its unstable state for approximately 5 seconds, it returns to the stable state. At this time the control voltages return to their original levels, in the same sequence but with slightly altered timing to end the calibration cycle.

A7A1 20 MHz Mixer Assembly (Service Sheet 7)

The A7A1 assembly includes a phase detector which compares the frequency of the 20 MHz VCO with the 20 MHz reference oscillator in the 8660 mainframe. A dc error voltage is produced which draws the VCO frequency back to the 20 MHz. This occurs only during the FM CF CAL sequence.

A7A2 20 MHz Switch Assembly (Service Sheet 7)

The A7A2 assembly contains relays which serve to route the 20 MHz reference signal back to the System's RF Section in the OFF or ϕM modes. In the FM Mode, the 20 MHz reference is coupled to another relay which passes the signal to the A7A1 phase detector only during the FM CF CAL sequence.

A7A3 20 MHz Voltage Controlled Oscillator Assembly (Service Sheet 7)

The A7A3 assembly contains the 20 MHz VCO, isolation amplifiers, and error voltage amplifier (active low pass filter) for the phase lock loop.

Normally, a stored dc voltage at the error amplifier input holds the VCO output very close to 20 MHz. Over a period of time, the stored voltage will leak away causing a progressively greater output frequency deviation.

During the FM CF CAL sequence, a dc error voltage produced by the phase difference between the 20 MHz reference and the VCO output is passed through a relay to the error voltage amplifier. Its output causes the VCO frequency to come closer to the reference frequency. After the two frequencies have reached a minimum difference, the calibration cycle ends and the relay opens. The quiescent dc voltage which holds the VCO output at 20 MHz is stored at the error amplifier input.

A8 Mother Board Assembly (No Service Sheet)

The A8 Mother Board Assembly provides interface between plug-in circuit boards and the connector to the mainframe. Inductors and capacitors on this board form filters for both dc supply lines and logic lines from the mainframe. This board is shown at the left and right hand portions of the individual service sheet schematics.

SERVICE SHEET 1 (Cont'd)

A9 Deviation Detector Assembly (Service Sheet 8)

The deviation detector circuits compare the peak modulation drive signal to a preset dc level corresponding to 110% of the full scale meter indication. If the modulation level is set to high, a one-shot multivibrator is triggered. This causes the front panel REDUCE DEVIATION lamp to be illuminated and a BUSY FLAG to be output to the mainframe. The busy flag inhibits the input of programmed data to the system.

The phase modulation signal from the A3 Remote Attenuator Assembly is amplified and input to the RF Section.

Troubleshooting

Malfunctions which appear to be a Modulation Section problem may in fact be in the mainframe or RF Section. The Modulation Section receives all dc power (—10, +5.25, and +20 Vdc) from the mainframe, a 20 MHz reference signal is generated in the mainframe, and in addition, remote programming is stored and clock pulses are generated in the mainframe. Phase modulation actually takes place in the RF Section while frequency modulation occurs in the Modulation Section. Therefore, make the following front panel tests before disassembling the instrument to search for the defective component.

Test Equipment

Oscilloscope . . . . . HP 180A/1801A/1821A
10:1 Oscilloscope Probe . . . . . HP 10004A
Test Oscillator. . . . . .HP 651B

Initial Test Conditions for Front Panel Tests

The Modulation Section must be installed in a Model 8660-series mainframe. The system must also include an RF Section and a Frequency Extension Module if required. Connect the oscilloscope to the RF Section output connector. Set MODE control to ϕM, SOURCE control to 400 Hz and center the MODULATION LEVEL control or set it for a half scale meter indication (if the meter is reading correctly). Turn instrument on and allow to warm-up for 10 minutes.

Front Panel Tests

Note the presence of modulation on the scope and the meter indication. Switch to FM and note FM modulation on scope, meter indication, and FM mode indicator on mainframe. If a further test is required, connect the audio oscillator to the INPUT/OUTPUT jack on the front panel of the Modulation Section and change the SOURCE control to EXTERNAL AC. This bypasses the internal oscillator and leveling amplifier. If a problem is indicated in the Modulation Section continue with the next step.

Test Equipment

Oscilloscope . . . . . HP 180A/1801A/1821A
10:1 Oscilloscope Probe . . . . . HP 10004A
Digital Voltmeter . . . . . HP 3480A/3482A
Extender Cable . . . . . HP 11672-60002

Initial Test Conditions for Internal Measurements

Turn off instrument. Unplug the Modulation Section from mainframe, remove covers, and reconnect module to mainframe using extender cable. See last foldout in this manual for procedures and cautions. Set front panel SOURCE control to 400 Hz and MODE control to ϕM. Turn on instrument and allow 10 minute warm up.

Test 1: Logic

Using a digital voltmeter check A2TP2 for a logic low. If the level is incorrect or if other logic problems are encountered, go to Service Sheet 2 for further tests.

Test 2: Modulation Oscillator

Use oscilloscope to check A5TP1 for the audio modulation signal as shown on the block diagram. A5TP1 is located at the bottom of the upper center slot on the right hand side of the Modulation Section assembly. If the signal is not present go to Service Sheet 3 for further tests.

Test 3: Leveling Amplifier

Leveling Amplifier problems are indicated by insufficient modulation drive signal or clipping of the drive signal. Use oscilloscope to check A4TPB for the voltage indicated on the block diagram. If the signal is incorrect go to Service Sheet 4 for further tests.

Test 4: Level Control

Use oscilloscope to check A3TP1 for the signal shown on the block diagram. If the signal is incorrect, go to Service Sheet 5 for further tests.

SERVICE SHEET 1 (Cont'd)

Test 5: FM Modulation Drive Signal

Use oscilloscope to check A6TP4 for the signal shown on the block diagram. If this signal is incorrect, go to Service Sheet 6; if correct, go to Service Sheet 7.

Test 6: Phase Modulation Drive Signal

Use an oscilloscope to check the signal at A9TP1. If this signal is incorrect, refer to Service Sheet 8 and continue troubleshooting.

Table 8-1. Assembly Information Index

Assembly Numbers and Description	Service Sheet Number	Photograph Figure 8-
A1 Front Harness	2	25
A2 Switch Logic	2	6
A3 Remote Attenuator	5	13
A4 Level Amplifier	4	10
A5 Modulation Oscillator	3	8
A6 FM Attenuator	6	16
A7 Rear Panel		25
A7A1 20 MHz Mixer	7	18
A7A2 20 MHz Switch	7	18
A7A3 20 MHz VCO	7	19
A8 Mother Board		24
A9 Deviation Detector	8	21

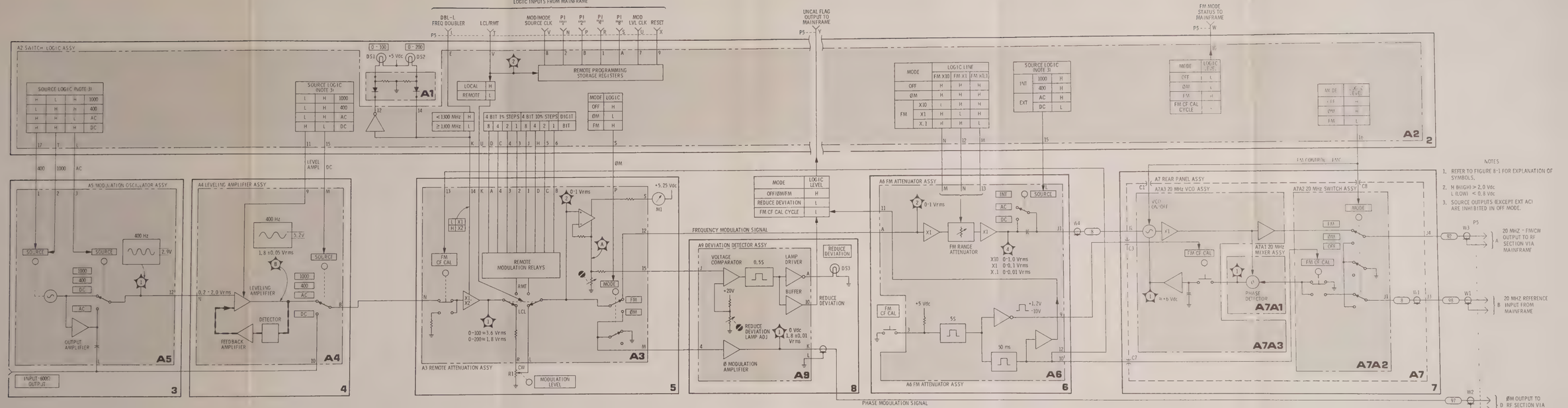


Figure 8-4. Troubleshooting Block Diagram

SERVICE SHEET 2

NOTE

Begin overall troubleshooting by first following the procedures given in Section VIII of the Model 8660 series mainframe Operating and Service Manual. After the trouble has been isolated to the 8635A Modulation Section, perform the overall troubleshooting even in this manual on Service Sheet 1. After both of these steps have been performed and the trouble has been isolated to the A2 Switch Logic Assembly, the following troubleshooting procedure is recommended.

A2 SWITCH LOGIC ASSEMBLY

PRINCIPLES OF OPERATION

The Switch Logic Assembly (A2) provides the interface capabilities to operate the Modulation Section from either front-panel controls or remotely programmed data (see Figure 8-5).

Local Mode Operation

In the local mode of operation all functions of the Modulation Section are controlled by front-panel controls. These consist of:

The MODE switch selects modulation of OFF, ϕM, FM X0.1, FM X1, or FM X10.

The SOURCE switch selects INTERNAL, 400 Hz, 1000 Hz; or EXTERNAL AC or DC inputs.

The MODULATION LEVEL control sets the ϕM or FM modulation as a percentage of full-scale indication on the meter.

The FM CF CAL switch temporarily locks the internal VCO (Voltage Controlled Oscillator) to a 20 MHz reference signal from the mainframe.

Refer to the Switch Logic Assembly schematic, Figure 8-7, when reading the following discussion.

In the local (front-panel) mode the LCL-RMT line input is high, which enables NOR gate U12A and inhibits Shift Registers A2U5/A2U6 and A2U9/A2U10. The High level to pin 1 of A2U4, and A2U7 Multiplexers inhibits the inputs from the shift registers and enables the local inputs, pins 3, 6, 13, and 10 from the front-panel switches. The High LCL-RMT voltage is also coupled to relays on the A3 Assembly which enable the front-panel MODULATION LEVEL control and inhibit the remote attenuator.

When a particular MODE or SOURCE function is chosen, the front-panel control is rotated to the proper position and the switch couples a High dc level (>+2.4V) to the appropriate multiplexer. The other inputs to the multiplexers are Low dc levels (<+0.8V). Because the local mode inputs to multiplexers have been enabled by the High level from the LCL-RMT control line to pins 1, the multiplexer input levels appear at their corresponding outputs.

MODE CONTROL

The A2U4 multiplexer outputs are inverted and the outputs from the A2 assembly are coupled to relays in the A3 assembly where ϕM or FM mode is selected and the A6 assembly where the FM range is selected (see Table 8-2).

SERVICE SHEET 2 (Cont'd)

FM Sense Circuit

A Low output from A2U8A pin 12, the FM SENSE circuit, indicates that FM has been selected as the mode of operation.

FM Control (FM-C) Circuit

The FM SENSE output is coupled through buffer A2U16A to activate three 20 MHz FM-CW relays on the A7A2 assembly and the VCO turn-on relay in A7A3.

FM Mode Circuit

A High FM SENSE output is coupled to A2U3A pin 1 when any FM range is selected. The normally High input (FM CF CAL FLAG from the FM center-frequency calibration timing circuit in the A6 Assembly plus the High from FM SENSE causes A2U3A pin 3 to go Low. This Low causes a High output at A2U15B pin 4 and causes the FM MODE lamp on the mainframe front panel to light. During the FM center frequency calibration cycle the FM CF CAL input from the A6 Assembly is Low, the output to the mainframe is Low, and the FM MODE lamp is off.

Mode Sense Circuit

When either ϕM or FM MODE is selected, the A2U8B NOR gate has a Low output which enables NOR gates A2U8C, A2U12B, C, and D. If the OFF MODE is selected, the output of A2U8B goes High, which inhibits A2U8C, A2U12B, C and D. The outputs of A2U11C, A2U11D, A2U14E, and A2U15C are held High (off).

Meter Range and Indicator Circuit

In FM MODE, the High output from A2U2E pin 10 enables gates A2U3B and C. If the system is operating below 1300 MHz a High input is applied at A2U2D pin 9 and A2U3B pin 5. This High input results in Low output at A2U1A pin 3 and a high output at A2U1B pin 5. The Low at A2U1A biases A1CR1 and provides the ground to turn meter 0-100 indicator DS1 on. The High at A2U1B pin 5 reverse-biases A1CR2 to cut off the 0-200 indicator DS2 current path. For frequencies ≥1300 MHz the output polarity of A2U1A and B is reversed and DS2 is on and DS1 is off. The output of A2U1B pin 5 is also used when DS2 (≥1300 MHz) is on, as the X2 GAIN CONTROL output. This signal is used in A5 to halve the modulation gain during ≥1300 MHz operation.

Source Control Circuit

As long as A2TP1 (MODE SENSE) is Low, the SOURCE outputs from A2 Switch Logic Assembly are dependent upon the state of the outputs of the A2U7 Multiplexer. The LEVELING AMP ON output turns the A4 Leveling Amplifier on (low) in any SOURCE mode except EXTERNAL DC. The EXTERNAL DC, INTERNAL 400, and INTERNAL 1000 control output lines from the A2 Assembly are

SERVICE SHEET 2 (Cont'd)

inverted with respect to the A2U7 Multiplexer output pin 7, 12, and 9 respectively. These outputs are Low (<+0.8 Vdc) when they are selected as the SOURCE mode. These outputs activate relays on A3, A4 and A6.

The EXTERNAL AC output is independent of the MODE SENSE circuit. Inverting amplifier A2U15A inverts the A2U7 pin 4 output. This output is coupled to a relay in the A5 Assembly which selects either INTERNAL (High input) or EXTERNAL AC (Low input) modulation sources.

Remote Mode Operation

Remote programming data is first entered into temporary registers in the mainframe from the rear-panel REMOTE INPUT jack. Upon receipt of an address command, the data is clocked, digit first, into the correct plug-in's corresponding registers.

MOD. LEVEL Shift Register. Shift register A2U9 and A2U10 convert the serial BCD data at XA2 pins A, 1, B, and 2 into a pair of four-line parallel outputs to control the ϕM degree of modulation or the FM% of full-scale meter frequency deviation. This information is clocked from the mainframe temporary storage register by a series of ten clock pulses on XA2 pin 7. Since only two digits are required to program ϕM degree — FM deviation, the first eight clock pulses will be ignored. When the ninth clock pulse appears, the data is transferred to the input of A2U10. When the tenth clock pulse appears, the first digit is transferred to the output of A2U10 and the next digit in the serial chain is transferred to the otupt of A2U9 (input of A2U10).

A negative RESET pulse at XA2 pin 9 clears (sets all outputs Low) A2U9, A2U5, A2U10 and A2U6 when the instrument is first turned on.

MODE/SOURCE Shift Register. Shift registers A2U5 and A2U6 are also connected in parallel to the serial BCD data at XA2 pins A, 1, B, and 2. This data controls, through shift registers A2U5 and A2U6, the choice of MODE (CW, ϕM, or FM) and SOURCE (INTERNAL 400 or 1000, or EXTERNAL AC or DC). This information is clocked from the mainframe storage registers in the same manner as the MOD. LEVEL previously discussed.

In Local mode the LCL-RMT input at XA2 pin V is High and the output of AND gate A2U16B is High. This makes the output of A2U12A Low. The Low is connected to the CLEAR (MR) terminals of the shift registers and holds the registers clear in Local mode. In Remote mode the LCL-RMT input at XA2 pin V is Low and the output of AND gate A2U16B is Low. These Lows make the output of A2U12A High, allowing the shift registers to receive data.

Multiplexers. In Remote mode the Low at LCL-RMT input is also applied to Multiplexers A2U4 and 7 at pin 1. This Low disconnects the Multiplexers from the Local mode input terminals (pins 3, 13,

SERVICE SHEET 2 (Cont'd)

6, and 10) and connects them to the Remote terminals (pins 2, 5, 14, and 11). The front-panel controls are not disabled, but their inputs are not connected to the outputs.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the A2 Switch Logic Assembly as a result of using the Troubleshooting on Service Sheet 1. Troubleshoot by using the test equipment and procedures specified below.

Test Equipment

Digital Voltmeter ..... HP 3480A/3482A
Extender Cable ..... HP 11672-60002

Initial Test Conditions

Modulation Section removed from mainframe but connected by an extender cable, covers removed, and the A2 Switch Logic Assembly Board installed on extender board (see Figure 8-2).

Test Procedure (1) (Manual Operation)

Before troubleshooting the A2 Assembly, verify that the power supply voltages are present (±0.25 Vdc). If the Model 8660 system is being operated in the local mode and the malfunctioning component has been isolated to the A2 Assembly, proceed to test 1-b.

Test 1-a. Change from remote mode to local mode and set the front-panel controls to correspond to the programmed functions. If the instrument functions properly in local mode, proceed to Procedure (2). If the problem remains, proceed to test 1-b.

Test 1-b. Set the Modulation Section front-panel controls to the malfunctioning position. Measure the voltage at A2TP2. If the voltage is Low (<+0.8 Vdc), proceed to Test 1-c. If the voltage is not Low, measure the dc voltage at A2U16B, pin 6. If the voltage is High (>+2.4 Vdc, correct for local mode), verify that the dc level at A2U16B pin 5 is >+2.4 Vdc. If this voltage is incorrect, A2U16B or A2U2F or U12A, or associated component is defective. If this voltage is correct, A2U12A or an associated component is defective.

Test 1-c. Verify that the correct dc voltage exists at A2TP1. The level should be High in OFF (CW) mode and Low in ϕM or FM mode. If the voltages are correct, proceed to Test 1-e. If one or both voltages are incorrect, proceed to Test 1-d.

Test 1-d. Measure the dc voltages at A2U4 output pins 4, 7, 9, and 12. Refer to Table 8-3. If all voltages are correct, proceed to Test 1g. If any of the voltages are incorrect, check the voltage level at the corresponding input. If the corresponding input voltages at pins 3, 6, 10 and 13 are correct, A2U4 is probably defective. If an input voltage is incorrect, the MODE control switch A1S2, the XA2 connector, or the wiring is defective.

SERVICE SHEET 2 (Cont'd)

Test 1-e. Verify that the correct dc levels are found at A2U11B pin 4, A2U15F pin 12, A2U15E pin 10, and A2U15B pin 4 by referring to Table 8-2. If any of the outputs of A2U11 or A2U15 are not inverted with respect to inputs the part is probably defective.

Test 1-f. Measure the outputs of A2U7 at pins 4, 7, 9, and 12. Refer to Table 8-3. If the voltages are correct, proceed to Test 1-h. If an output voltage is incorrect, measure the corresponding input voltages to A2U7 at pins 3, 6, 10, and 13. Refer to Table 8-3. If an input voltage is correct but the corresponding output voltage is incorrect, probably A2U7 is defective.

Test 1-g. Measure voltage at A2U8B pin 3. Voltage should be <+0.8V in the OFF or ϕM modes and >+2.4V in the FM mode. If these voltages are correct A2U8 is probably defective. If the voltage is incorrect, A2U8 or A2U3 probably is defective.

Test 1-h. Refer to Table 8-3 and check voltages on A2U15C pin 6, A2U15A pin 2, A2U11C pin 10, A2U14E pin 10, and A2U8C pin 10. If the voltages are correct, proceed to Test 1-j. A2U11D pin 11 output is incorrect, probably A2U11 is defective. If any other voltages are incorrect, proceed to Test 1-j.

Test 1-i. Refer to the schematic on Service Sheet 2 and check the input voltage to the last circuit element (inverter or NAND gate) on the malfunctioning line. If this voltage is correct, the last circuit element is defective. If this voltage is incorrect, one of the proceeding NOR gates is defective or the input to the output gate is shorted.

Test 1-j. Verify that the voltage at A2U16A pin 3 is correct. The voltage should be >+2.4V in OFF and ϕM modes and <+0.8V in the FM mode. If the voltages are correct, proceed to test 1-k. If the voltages are incorrect, probably A2U16A is defective.

Test 1-k. Verify that the mainframe panel lamp, FM MODE, is lighted in the FM mode and is extinguished in the OFF and ϕM modes and during the FM CF CAL cycle. If the lamp is operating correctly, proceed to Test 1-m. If the lamp is not operating correctly, proceed to Test 1-l.

Test 1-l. Check the voltage at A2U15B pin 4. The voltage should be <+0.8V in the OFF and ϕM modes and during the FM CF CAL cycle, and >+2.4V in the FM mode. If the voltage is correct, proceed to Test 1-m. If the voltage is not correct, verify that the voltage at A2U3A pin 2 is >+2.4V in FM mode and <+0.8V during the FM CF CAL cycle. If the voltages are incorrect, the A6 FM CF CAL timing circuit, associated components on the A8 Assembly, or continuity between A6 and A2 is the cause (see Service Sheet 6). If the voltages are correct, probably A2U3 or A2U15 is defective.

Troubleshooting Block Diagram
SERVICE SHEET 1

Table 8-2. Truth Table for MODE Functions

MODE	ϕM ON (S)*	FM X0.1(M)	FM X1(2)	FM X10(N)	FMC (16)	FMMODE(10)
OFF	H	H	H	H	H	L
ϕM	H	H	H	H	H	L
FM X0.1	H	L	H	H	L	H
FM X1	H	H	L	H	L	H
FM X10	H	H	H	L	L	H

*XA2 Pin No.
H = >+2.4V, L = <+0.8V

Table 8-3. Truth Table for SOURCE Functions

MODE	SOURCE	AMP(11*)	EXT AC(L)	EXT DC(15)	INT 400(17)	INT 1000(T)
OFF	any	H	X	H	H	H
ϕM	EXT AC	L	L	H	H	H
ϕM	DC	L	H	L	H	H
FM	INT 400	L	H	H	L	H
	1000	L	H	H	H	L

*XA2 Pin No.
X may be H or L. Level is dependent upon SOURCE setting only. H = >+2.4V, L = <+0.8V

Test 1-m. Verify that the correct dc voltages exist at A2U1A pin 3, and A2U1B pin 5. In ϕM mode A2U1A pin 3 should be <+0.8V and A2U1B pin 5 >+2.4V. In <1300 MHz FM mode A2U1B pin 5 should be >+2.4V and A2U1A pin 3 <+0.8V. In ≥1300 FM mode, A2U1B pin 5 should be <+0.8V and A2U1A pin 3 >+2.4V. If voltages are correct, proceed to Test 1-o, otherwise proceed to Test 1-n.

Test 1-n. If voltage at A2U1A pin 3 or A2U1B pin 5 is not correct, probably A2U1 or A2U3 is defective.

Test 1-o. If there is still a malfunction associated with a specific input or output, check the connectors, printed circuits, and wiring for continuity. When an output or input has components on the A1 or A8 Assembly, they should be checked for proper operation.

Test Procedure (2) (Remote Operation)

Program the mainframe for remote operation. The following tests assume that the instrument functions normally in the manual mode. If not, go to Test Procedure (1).

Test 2-a. Verify that the dc voltage at A2TP2 is >+2.4V. If the voltage is correct, go to Test 2-d. If the voltage is incorrect, proceed to Test 2-b.

Test 2-b. Check the voltage at A2U2F pin 13 for >+2.4V to make sure the shift registers are not being held permanently in a clear state. If the level is >+2.4V, proceed to Test 2-c. If the voltage is <+2.4V, check continuity to the mainframe from A2U2F pin 13, and check that the components on A8 Assembly are operating properly. If there is a problem with the components or the cables and connectors, repair or replace the defective part. If everything is correct, refer to the DCU Troubleshooting in the mainframe manual.

Test 2-c. Measure the voltage at A2U12A pin 2. If the voltage is <+0.8V, A2U12 is probably defective. If the voltage is not <+0.8V, measure the voltage at A2U16B pin 6. This voltage should be <+0.8V. If this voltage is correct, A2U16B or an associated component is defective. If the voltage is incorrect, check A8 components, resistance to ground and the continuity to the mainframe from A2U16B pin 6. If continuity is broken or is grounded, repair or replace the defective component. If continuity is unbroken and not grounded, refer to DCU Troubleshooting in the mainframe manual.

SERVICE SHEET 2 (Cont'd)

Test 2-d. Remove short from J3 pin 5 (Remote inputs) jack on the back of the mainframe and then reconnect the short. (This sends a clear pulse to all shift registers.) Measure the voltage at the outputs of A2U9, A2U5, A2U10, and A2U6, pins 12, 13, 4, and 15. All of these voltages should be $<+0.8V$. If any output is not $<0.8V$, the integrated circuit whose output is incorrect is probably defective. If all the outputs are correct, proceed to Test 2-e.

Test 2-e. Measure the voltage at the outputs of A2U13 pins 3, 4, 10, and 11, and A2U14 pins 2, 4, 5, and 6. All of these voltages should be $>+2.4V$. If any output is not $>+2.4V$, the integrated circuit whose output is incorrect is probably defective. If all of the outputs are $>+2.4V$, proceed to Test 2-f.

Test 2-f. Measure the voltage at the outputs of A2U4 and A2U7 pins 4, 7, 12, and 9. All of these voltages should be $<+0.8V$. If true, proceed to Test 2-g. If any output is not $<+0.8V$, the integrated circuit whose output is incorrect is probably defective.

Test 2-g. Connect +5 Vdc to A2U9 pins 4, 5, 6, and 7. Momentarily connect +5 Vdc to A2U9 pin 10 twice. Repeat with A2U5 pin 10. This action clocks Highs throughout all shift registers. Trace the malfunctioning circuit through the shift registers. All outputs of both shift registers should be $>+2.4V$. If the outputs are correct, proceed to Test 2-h. If A2U9 and A2U10 have corresponding outputs incorrect, probably A2U9 is defective. If A2U5 and A2U6 have corresponding outputs incorrect, A2U5 is probably defective. If only A2U10 or only A2U6 has an incorrect output, probably the integrated circuit whose output is incorrect is defective.

Test 2-h. Measure the outputs of A2U13 pins 3, 4, and 10 and A2U14 pins 4, 8, and 6. They should be $<+0.8V$. If any output is not $<+0.8V$, the integrated circuit whose output is incorrect is probably defective. If all outputs are correct, proceed to Test 2-i.

Test 2-i. Measure the outputs of A2U4 and A2U7, pins 4, 7, 9 and 12. They should all be $<+0.8V$. If any output is not $<+0.8V$, the integrated circuit whose output is incorrect is probably defective. If all outputs are correct, proceed to Test 2-j.

Test 2-j. Verify that continuity to the mainframe exists from all shift register inputs and that the associated components on the A8 Assembly are operating properly. If continuity does exist and the components on the A8 Assembly are operating properly, go to the DCU Troubleshooting in the mainframe manual. If continuity does not exist, if the circuit is grounded, or the components on the A8 Assembly are defective, repair or replace the defective component.

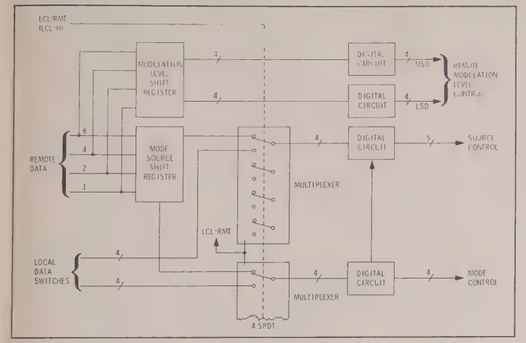


Figure 8-5. Simplified Switch Logic Block Diagram

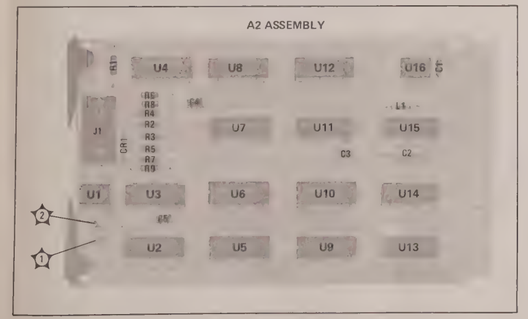


Figure 8-6. A2 Switch Logic Assembly Component Locations

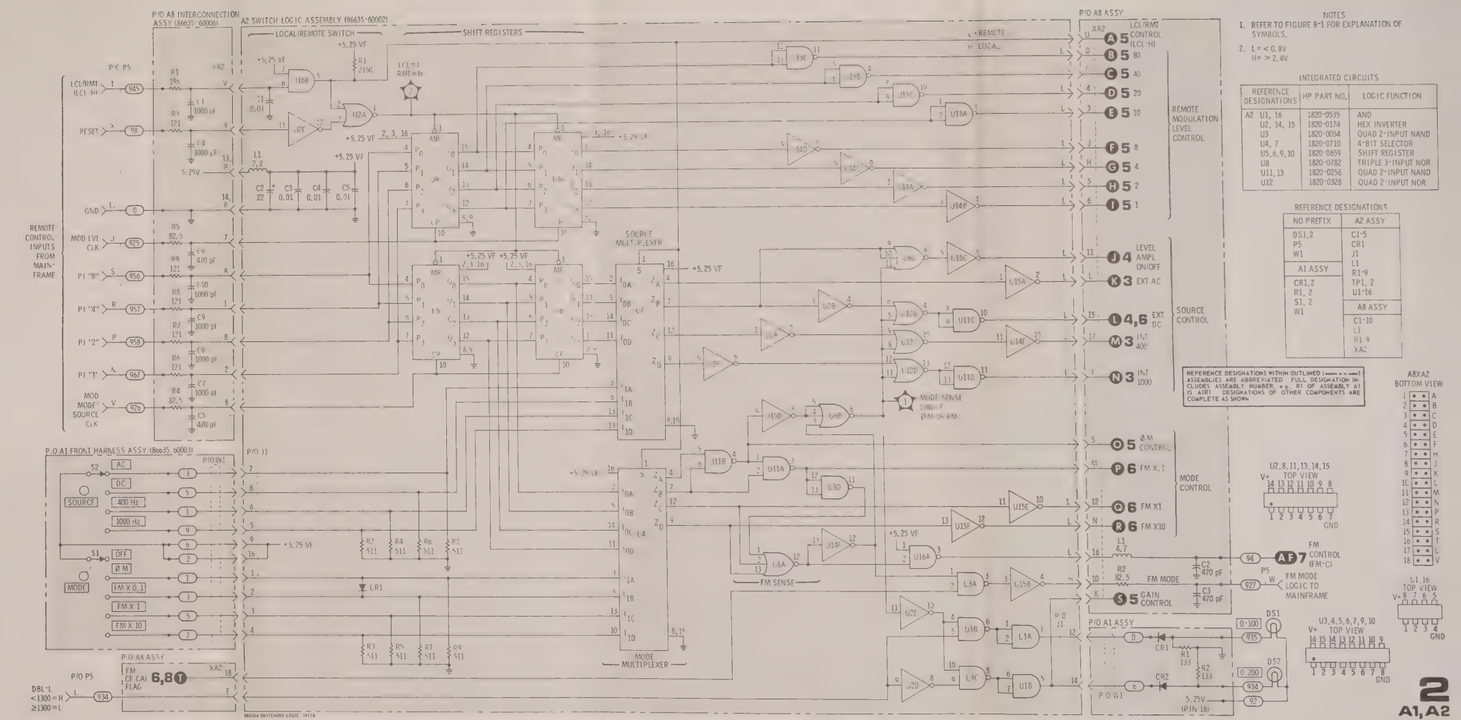


Figure 8-7. A2 Switch Logic Assembly Schematic Diagram

SERVICE SHEET 3

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting. If this indicates trouble in the Model 86635A Modulation Section, proceed to Service Sheet 1 of this manual. Service Sheet 1 gives overall troubleshooting and is keyed to all other Service Sheets.

A5 MODULATION OSCILLATOR

PRINCIPLES OF OPERATION

The A5 Modulation Oscillator Assembly contains the 400 Hz or 1000 Hz oscillator circuit and related relay switching. This oscillator generates the internal drive to the A4 Leveling Amplifier Assembly. In the INTERNAL SOURCE switch positions, a buffer amplifier provides isolation coupling between the internal oscillator and the front-panel OUTPUT connector. The internal oscillator is turned off in both the OFF and EXT modes. In EXT mode the external input is routed to the output by the switching relay.

Oscillator Control Circuits

All control logic for the A5 Modulation Oscillator Assembly is derived from the A2 Switch Logic Assembly. A logic low at either XA5 pin 1 (400 Hz ON) or XA5 pin 2 (1000 Hz ON) will turn on both A5Q1 and A5Q2, thus coupling −9 Vdc to the modulation oscillator A5U1. A logic low at XA5 pin 2 will also close relay A5K1, changing the oscillator frequency from 400 Hz to 1000 Hz.

Modulation Oscillator

The A5U1 oscillator consists of two feedback loops which control frequency and output amplitude. The frequency sensitive bridged-Tee network selects the frequency of minimum feedback (400 Hz or 1000 Hz). The other feedback circuit through A5R14 provides positive feedback required for oscillation. A5CR5 through A5CR8 form an automatic gain control circuit limiting the amplitude of the oscillator output to about 2.8 Vp-p or 1 volt rms. In INTERNAL mode buffer amplifier A5Q3 provides isolation and signal coupling to front panel connector J1.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Modulation Oscillator Assembly as a result of using the procedures on Service Sheet 1. Troubleshoot the A5 Modulation Oscillator by using the test equipment and procedures given below.

A2 Logic Control Assembly
SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

Test Equipment

Digital Voltmeter	HP 34740A/34702A
Test Oscillator	HP 651B
Oscilloscope	HP 180C/1801A/1821A
10:1 Oscilloscope Probe	HP 10004A
Extender Cable	HP 11672-60002

Initial Test Conditions

Turn off instrument. Unplug the Modulation Section from mainframe, remove covers, install A5 Modulation Oscillator Assembly board on extender board and reconnect module to mainframe using extender cable. See last foldout in this manual for procedures and cautions. Set front panel SOURCE control to 400 Hz. Turn on instrument and allow 10 minute warm up.

NOTE

Perform adjustment procedure entitled Modulation Oscillator Adjustment in Section V after making repairs to any part of the modulation oscillator circuits.

Test Procedures

Test 1: Power Supplies

Verify that the power supply voltages at XA5 pins H, F, and E are as shown on the schematic diagram. Verify that the +10 VF, +5.25 VF, and −9 VF are within ±0.25 Vdc. If the −9 VF is absent, check XA5 pin 1 for a logic low at the anode of A5CR1 with SOURCE control set to 400 Hz or 1000 Hz.

Test 2: Logic Switching

Monitor −9 VF with voltmeter while changing front panel SOURCE control positions. The −9VF should be present in the 400 Hz and 1000 Hz modes and off in the OFF and EXT modes. If the voltage is incorrect, check A5Q1, A5Q2, and associated components.

Test 3: A5U1 Oscillator Circuit

First use oscilloscope to check both ac level and dc offset at A5U1 pin 6 for the voltage shown on the schematic diagram and proceed to the next appropriate step.

Test 3a: Incorrect Amplitude

If the oscillation is present but has the incorrect amplitude, the problem is in the dc feedback loop. Check A5C8 for a signal level of about one-half the value found at A5U1 pin 6. Check A5C7 for a dc voltage of about +0.8 Vdc. Turn off mainframe power, remove the A5 Assembly board from extender card. Check the components in the dc feedback loop starting in area where incorrect voltage was found. Replace the defective component.

Test 3b: Incorrect Frequency

If the signal is present but cannot be adjusted to correct frequency, turn off mainframe power and remove the A5 Assembly board from extender card. If the 400 Hz signal is incorrect, use ohmmeter to check A5R8, A5R12, A5R15, or A5R18 for value change. If only the 1000 Hz signal is incorrect, the defective component is A5K1, A5R13, A5R16, or A5CR4.

Test 3c: No Signal

Turn off mainframe power, remove the A5 Assembly board from extender card and check A5C9 and A5C12 for shorts and A5R14 for a high value or open. If these components are good, A5U1 is probably defective and needs replacing.

Test 4: Output Amplifier

Use the digital voltmeter to check the base and emitter of A5Q3 for the voltages given on the sshematic diagram. If no voltage is present at the emitter, A5Q3 is open. If the dc voltages are correct, use the oscilloscope to check the signal at the emitter of A5Q3. If correct, check toward the front panel jack, if not, check back toward the oscillator to locate the defective component.

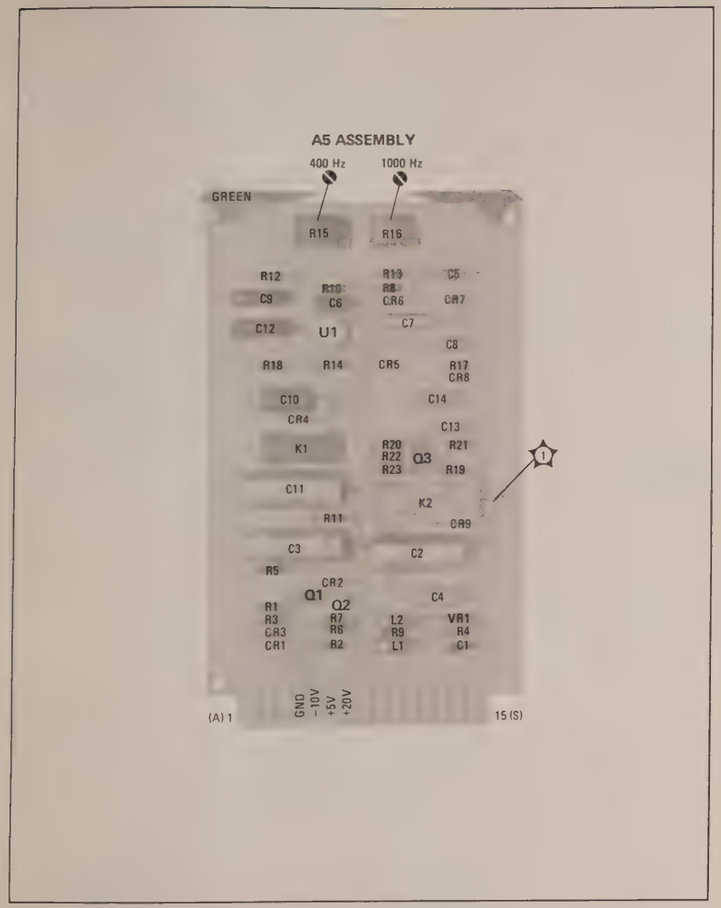


Figure 8-8. A5 Modulation Oscillator Assembly Component Locations

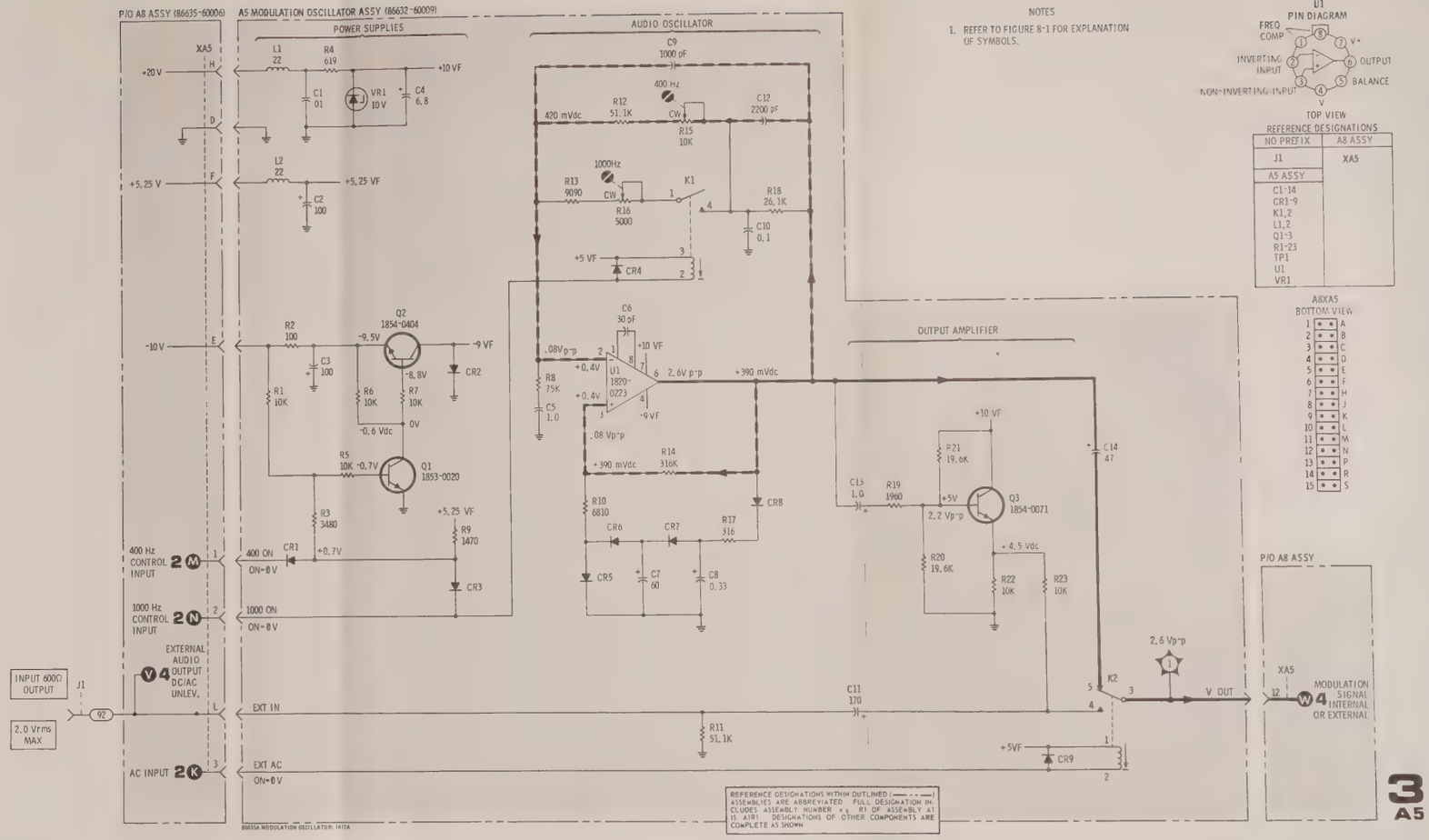


Figure 8-9. A5 Modulation Oscillator Assembly Schematic Diagram

SERVICE SHEET 4

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting. If this indicates trouble in the Model 86635A Modulation Section, proceed to Service Sheet 1 of this manual. Service Sheet 1 gives overall troubleshooting and is keyed to all other Service Sheets.

A4 LEVELING AMPLIFIER ASSEMBLY

PRINCIPLES OF OPERATION

The A4 Leveling Amplifier maintains a constant output voltage for internally generated signals or for external ac-coupled signals in the range of 1.0 to 2.0 Vrms. The specified frequency range of the external source is 20 Hz to 100 kHz.

Leveling Amplifier Control Circuits

The Leveling Amplifier is turned on only in the INTERNAL or EXTERNAL AC coupled SOURCE modes. A logic low is coupled to XA4 pin 9 from the A2 Logic Control Assembly in these positions. This turns off A4Q12 and turns on A4Q11. Turning on A4Q11 applies positive supply voltages to the Leveling Amplifier. In a similar manner, A4Q3 is turned off and A4Q4 is turned on, which applies negative supply voltages to the Leveling Amplifier.

In the EXTERNAL DC mode, the voltage at pin 9 is High, which turns off the Leveling Amplifier. At the same time the voltage at XA4 pin M (DC CONTROL) is Low. This actuates relay A4K1, connecting the INPUT/OUTPUT jack through the A4 Assembly to the A3 Modulation Level Control Assembly.

Modulation Signal Amplifier

The modulation signal amplifier section of the Leveling Amplifier Assembly is a five stage transistor amplifier. The input stage consists of A4Q10 buffer amplifier. A4R14 is an optically coupled isolator which controls the overall gain. A4Q6 is a buffer amplifier with a voltage gain <1. A4Q5 and A4Q7 are voltage amplifiers with a gain of about 30. A4Q7 drives the complementary pair A4Q8 and A4Q9 to provide a low impedance output.

Detector and Feedback Amplifier

The output signal from the modulating signal amplifier is coupled to a peak detector circuit consisting of A4CR7, A4CR8, and A4CR9. The detected dc level is coupled to A4U2. The output of A4U2 (pin 6) is coupled to summing amplifier A4U1 through variable resistor A4R45. The offset voltage (A4TPE) and the output of A4U2 are summed, amplified and inverted by A4U1. The gain of A4U1 (nominally X1) is determined by gain control A4R45. The output of A4U1 is coupled through A4R47 to A4Q1 and A4Q2, the optical isolator drivers.

SERVICE SHEET 4 (Cont'd)

As the input signal to the modulation amplifier increases, the driving current to A4R14 photo-resistor is decreased. The signal coupled through the optically coupled isolator is decreased and the amplifier provides a constant output level of 1.80 ±0.02 Vrms.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Leveling Amplifier Assembly as a result of using the procedures on Service Sheet 1. Troubleshoot the A4 Leveling Amplifier by using the test equipment and procedures given below. Refer to Table 1-2 for a list of recommended test equipment.

Test Equipment

Digital Voltmeter	HP 34740A/34702A
Test Oscillator	HP 651B
Oscilloscope	HP 180C/1801A/1821A
10:1 Oscilloscope Probe	HP 10004A
Extender Cable	HP 11672-60002

Initial Test Conditions

Turn off instrument. Unplug the Modulation Section from mainframe, remove covers, install A4 Leveling Amplifier Assembly board on extender board, and reconnect module to mainframe using extender cable. See last foldout in this manual for procedures and cautions. Set front panel SOURCE control to 400 Hz. Turn on instrument and allow 10 minute warm up.

NOTE

Peform adjustment procedures entitled Amplitude Leveling Adjustment in Section V after making repairs to any part of the leveling amplifier circuits.

Test Procedures

Test 1: Power Supplies

Verify that the power supply voltages at XA4 pins 6, 7, and E are shown on the schematic diagram. Verify that the +20 VF, +10 VF, and the —10 VF are correct ±0.25 Vdc. If any of these voltages are absent, verify that XA4 pin 9 is at a logic low (with front panel SOURCE control *not* in DC) and then locate the faulty component by checking the dc voltages shown on the schematic diagram.

SERVICE SHEET 4 (Cont'd)

Test 2: Modulation Signal Amplifier

Use oscilloscope to verify input at XA4 pin N (about 2.8 Vp-p) and then check the output at XA4 pin B (about 5.2 Vp-p). If no output signal is present, move the probe to A4TPB and if the signal is present at this point relay A4K1 or associated circuits are at fault. If no signal is present or if the signal is not to specifications, proceed to the next test.

Test 2-a: Input Stage

Move the oscilloscope probe to test point A (about 1.3 Vp-p) and then to the emitter of A4Q10. If a signal is incorrect, turn off mainframe power and use ohmmeter to locate faulty component. If the signal at the emitter of A4Q10 is correct, use digital voltmeter to check A4TPE and A4U2 pin 3 for the dc voltages indicated on the schematic diagram. If these tests fail to locate the fault proceed to the next step.

Test 2-b: Open Loop Troubleshooting

Use an external signal generator to feed a 400 Hz signal (about 0.1 Vp-p) into the front panel jack of the Modulation Section. Set the SOURCE control to EXTERNAL AC. Use a clip lead to short across capacitor A4C17. The A4 Assembly is now ready for open loop testing.

Check A4TP1 (about —0.8 Vdc); if no voltage, check A4Q1 and A4Q2 for open. Use oscilloscope to check signal at A4TPB (about 5.2 Vp-p). If correct, proceed to test 2-d; if incorrect, proceed to test 2-c.

Test 2-c: Signal Amplifier

Move the probe to A4TP3 (about 0.18 Vp-p). Locate the faulty component by continuing to check half-way between the last correct and first incorrect signal. When the fault has been isolated to a stage, use digital voltmeter to check dc voltages given on the schematic diagram.

Test 2-d: Detector/Feedback Amplifier

First check test points C, D, E, and F for the voltages indicated using a digital voltmeter. Check any voltage given for the stage preceding the first incorrect reading and then disconnect power and use ohmmeter to locate the faulty component.

After repairs, remove the clip lead and perform adjustment found in Section V.

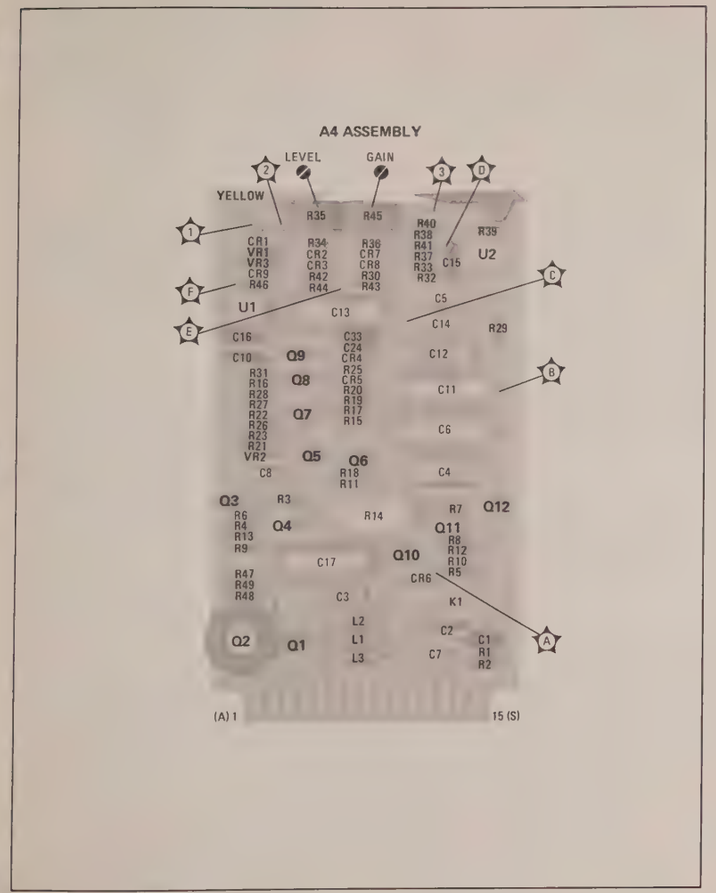


Figure 8-10. A4 Leveling Amplifier Assembly Component Locations

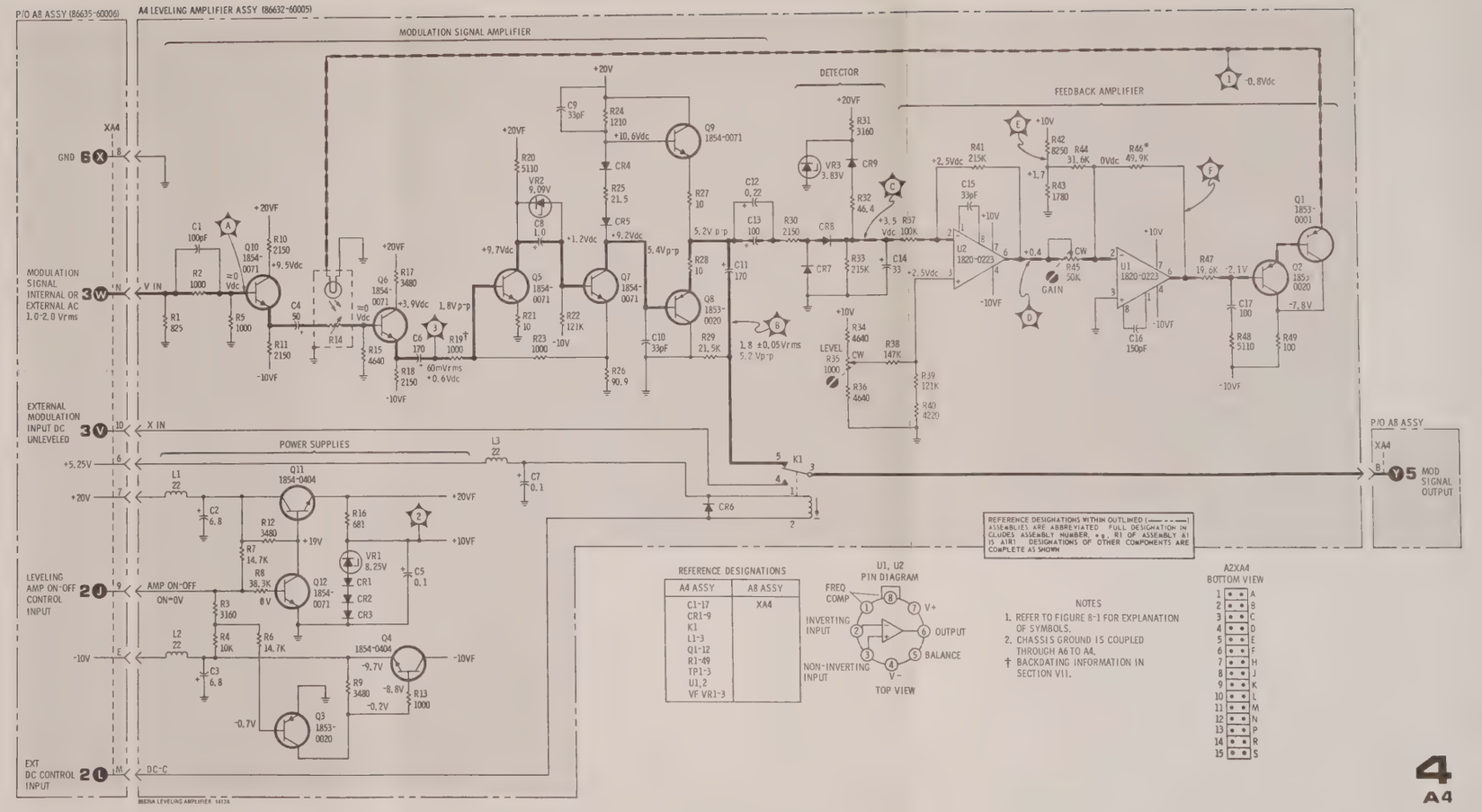


Figure 8-11. A4 Leveling Amplifier Assembly Schematic Diagram

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting. If this indicates trouble in the Model 86635A Modulation Section, proceed to Service Sheet 1 of this manual. Service Sheet 1 gives overall troubleshooting and is keyed to all other Service Sheets.

A3 REMOTE ATTENUATION ASSEMBLY

PRINCIPLES OF OPERATION

The A3 Modulation Level Control Assembly contains relays for selecting amplifier gain, local or remote operation, ϕM or FM mode, FM CF CAL, and remote modulation level. The output of the assembly is either a ϕM or FM modulating signal. All switching control voltages are derived from the A2 Switch Logic Assembly. A meter drive circuit, located on this circuit board, provides meter current and originates the REDUCE DEVIATION indicator signal.

FM CF CAL Decoupling Switch

When in FM mode and the front panel FM CF CAL control is depressed, relay A3K11 is energized and the modulation input at pin N is disconnected from A3Q3. During normal ϕM or FM mode operation, the input at pin 13 is high and the signal input at pin N is applied by relay A3K11 to audio amplifier A3Q3.

Local/Remote Switching

Relays A3K13 and A3K14 control the Local/Remote switching. In Local mode the relays are not energized and the audio modulation signal is routed to the front panel MODULATION LEVEL control. In the remote programming mode, these relays transfer the control of the modulation level to the Remote Modulation Level Control relays. Note that both relays must be active for the modulation signal to be present at the output.

Remote Modulation Level Control

Remote programming of the modulation level is achieved through control of relays A3K2 through A3K9 and resistors A3R10 through A3R25. Relays are selected by a 1, 2, 4, 8, 10, 20, 40, 80 code for percent. For example, if relays 1, 8, 10, and 80 are selected the modulation will be 99%. If the 20 and 80 relays are selected the modulation will be 100%.

Meter Drive

The meter drive amplifier consists of voltage comparator A3U2, transistor A3Q4 and associated components. The 0–1 Vrms attenuated modulation signal at pin 3 of A3K12 and 13 is the input to the meter drive amplifier. The signal is peak detected and stored on A3C10. The stored voltage sets the current flow to the meter. A feedback loop from A3Q4 emitter couples the voltage to the inverting input of A3U2. A3R33 slowly discharges A3C10, lowering the dc voltage coupled to the inverting input. As the next peak of

the input signal turns on the comparator A3C10 is again charged to the peak voltage. The meter is calibrated by adjusting A3R36 which is in both the meter circuit and the feedback loop. An output is taken from the emitter of A3Q4 through A3R46. This output is the DEVIATION DETECTOR SIGNAL used in A9 to generate the REDUCE DEVIATION indicator signal.

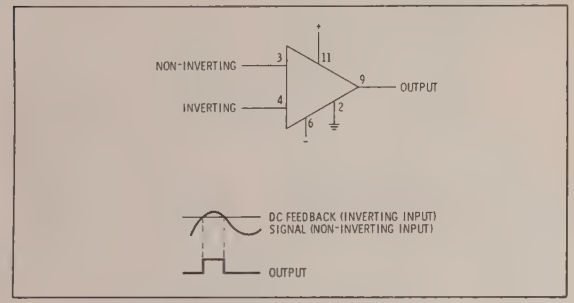


Figure 8-12. Voltage Comparator

Amplifier Gain Control

The gain control circuit changes the gain of the FM deviation drive signal when switching from lower to higher frequency bands. In FM mode, the GAIN CONTROL input at pin 14 goes from High to Low if the system operating frequency is switched from <1300 MHz (0—100 meter range) to a frequency ≥1300 MHz (0—200 meter range). The reverse is true when dropping from ≥1300 MHz to <1300 MHz.

When Low, GAIN CONTROL energizes A3K1, located in the feedback loop of amplifiers A3U1 and Q1. When energized A3K1 bypasses feedback loop resistor A3R39, and in effect divides the amplifeir gain in half, GAIN ADJ A3R7 is adjusted to obtain 3.6 Vrms (meter full scale) at A3TP1 at frequencies <1300 MHz and 1.8 Vrms at ≥1300 MHz. A2 logic switches on the 0—100 meter indicator for frequencies <1300 MHz or the 0—200 meter indicator for ≥1300 MHz.

ϕM/FM Selection

Relay A3K12 switches the modulation signal output from FM to ϕM when XA3 pin P of the circuit board goes low. Amplifier A3Q1 preserves the proper phase for driving the RF Section Modulator. Transistor A3Q5 inverts the ϕM control input logic so that A3K10 grounds the ϕM output when in FM mode.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Modulation Level Control Assembly as a result of using the procedures listed on Service Sheet 1. Troubleshoot the A3 Modulation Level Control Assembly by using the test equipment and procedures given below.

Test Equipment

Digital Voltmeter	HP 34740A/34702A
Oscilloscope	HP 180C/1801A/1821A
10:1 Oscilloscope Probe	HP 10004A
Test Oscillator	HP 651B
Extender Cable	HP 11672-60002

Initial Test Conditions

Turn off instrument. Remove the Modulation Section module from the mainframe, remove cover, connect to mainframe with extender cable. See last foldout in this manual for procedures and cautions. Remove the A3 Remote Attenuator Assembly board and reinstall using the extender board. Turn on instrument and allow 10 minutes warmup.

NOTE

Perform adjustment procedures entitled Amplitude Leveling and Meter Adjustment in Section V after making repairs to any part of the modulation level control circuits.

Test Procedures

Test 1: Power Supplies

Verify that the dc power-supply voltages are as shown on the schematic diagram and are within ±0.25 Vdc. If not, check the supply lines back through the A8 Mother Board to the mainframe and repair the malfunction.

Test 2: Modulation Amplifier

Set SOURCE control on front panel to 400 Hz and FM mode. Check A3TP1 with voltmeter for 3.6 Vrms with system frequency at 1200 MHz. Then switch to 1400 MHz and check for 1.8V rms. If the signal is incorrect, check for same signal level at base of A3Q1 to isolate the problem to one stage. Refer to Section V for adjustment of A3R37. Verify correct levels at pins 13 and 14.

Test 3: Controls

Move the voltmeter probe to A3TP2. An incorrect signal indicates a problem in A3K13, A3K14, the front panel Modulation Level control R1 in the local mode, or the Remote Modulation Level Control section of the A3 Board in the remote mode. Troubleshoot the remote level control circuits by programming through the mainframe and observing the level at A3TP2.

Test 4: Meter Driver

With 1.0 Vrms at A3TP2, check emitter of A3Q4 for ≈1.33 Vdc. If this voltage is incorrect, first check the collector of A3Q4 for power supply voltage and if this is present, adjust A3R36 by following the procedure given in Section V. If the fault has not been identified at this point, check A3U2 pins 11 and 6 for the supply voltages listed on the schematic. If these are correct, the fault lies with A3U2, A3Q4 or associated components.

Test 5: FM Output

Set MODE control to **FM X1** and check XA3 pin 12 with voltmeter for 1 Vrms signal. If no signal, probable cause is A3K12 or logic on the A2 Assembly.

Test 6: ϕM Output

Set MODE control to ϕM and check XA3 pin M for 1 Vrms signal. If no signal, probable cause is A3K10, K12, or logic in A2 Assembly.

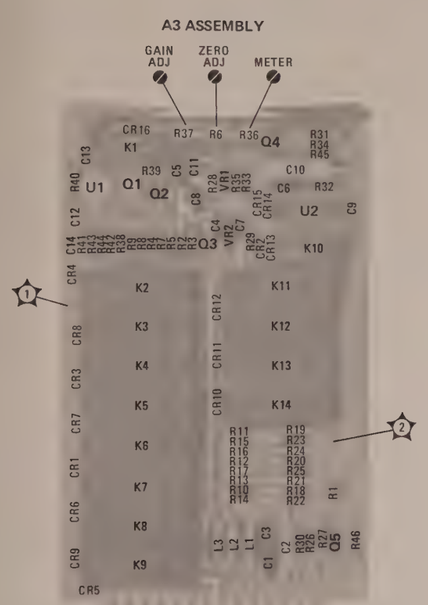


Figure 8-13. A3 Remote Attenuation Assembly Component Locations

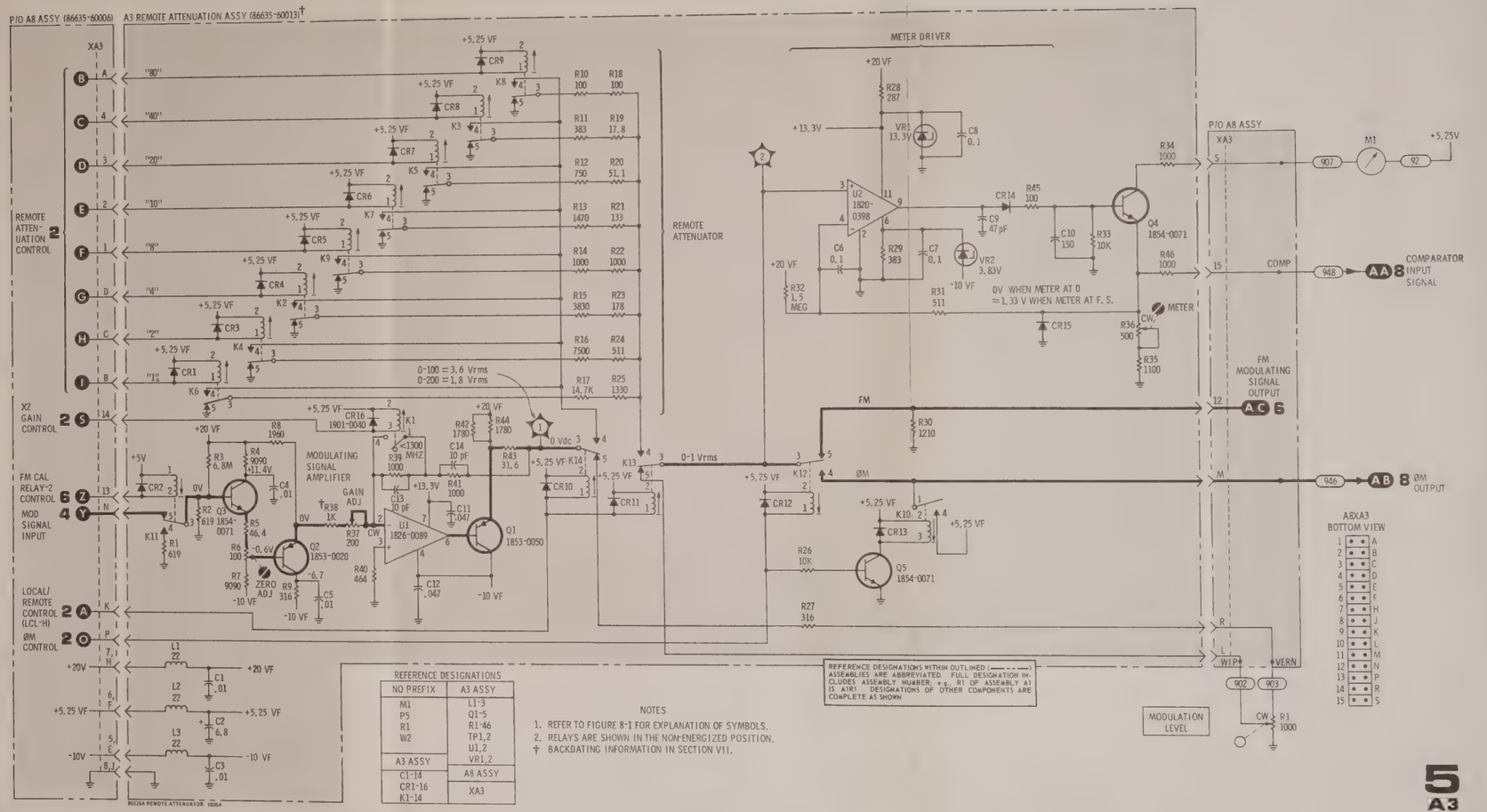


Figure 8-14. A3 Remote Attenuation Assembly Schematic Diagram

5 A3

SERVICE SHEET 6

NOTE

Begin overall troubleshooting by first following the procedures given in Section VIII of the Model 8660 series mainframe Operating and Service Manual. After the trouble has been isolated to the 86635A Modulation Section, perform the troubleshooting given in this manual on Service Sheet 1. After both of these steps have been performed and the malfunction has been isolated to the A6 FM Attenuator Assembly the following troubleshooting procedure is recommended.

A6 FM ATTENUATOR ASSEMBLY

PRINCIPLES OF OPERATION

The A6 FM Attenuator Assembly contains the FM range circuits. These circuits attenuate the amplitude of the modulating signal to predetermined levels with FM range switch settings. The A6 Assembly also contain the FM center-frequency calibration (FM CF CAL) timing circuits.

FM Range Control

The attenuated FM modulating signal from the A3 Remote Attenuator Assembly is coupled to the Complementary Emitter-Followers, A6U1B/U1C. The signal is then coupled to the FM range selector.

In the FM X10 range, the signal is coupled through resistor A6R25 and relay A3K1 to U1A and U1D emitter-follower. In the FM X1 and FM X0.1 ranges the output amplitude (to U1A) is respectively 1/10th and 1/100th of the output of the FM X10 range.

The output from the A6 Assembly is coupled to the A7 Assembly, to frequency modulate the 20 MHz VCO. In EXT DC mode a Low at pin L energizes relay A6K4 to bypass capacitor A6C23 in the output line.

FM CF CAL Circuit

In OFF or ϕM mode, U2A pins 1, 2, and 13 are High (>+2.4 Vdc) which causes the output, pin 12, to go Low (+0.8 Vdc). This Low is coupled to the base of transistor A6Q6 by A6CR2. The Low at the base of A6Q6 makes it impossible to trigger the A6Q4/Q5 multivibrator. In any FM MODE, U2A pin 12 is High but the Low at U2C pin 8 continues to keep the multivibrator from triggering. When the FM CF CAL front panel switch is closed or when a High calibration clock pulse is received at U2B pins 3, 4, and 5, U2B pin 6 goes Low. This Low sends pin 8 of U2C High, which turns A6Q6 on.

When A6Q6 is turned on, several events occur:

a. Multitvibrator A6Q4/Q5 is triggered, Transistor A6Q5, which is normally conducting, is turned off and A6Q4 is turned on. This condition remains until the charge on A6C9 builds up to the combined threshold of A6Q5 and the voltage drop across A6CR5. At this time the multivibrator returns to its steady state condition. Cycling time for this operation is approximately 5 seconds.

SERVICE SHEET 6 (Cont'd)

b. Transistor A6Q3 is turned on, changing the collector voltage (normally −10 Vdc) to approximately +1.2 Vdc. This voltage, fed to the hold control relay over the HLC line, closes this relay in the A7 Assembly.

c. Transistors A6Q1, and A6Q2 are turned on, causing the FM CAL FLAG output to go Low. This output to the mainframe inhibits transfer of programmed data for the Modulation Section from the mainframe. This output also goes to the Modulation Section A2 Switch Logic Assembly and is transformed to a signal to the mainframe (FM MODE). This signal turns off the FM MODE light in the mainframe for the duration of the calibration cycle.

d. When A6Q5 turns off, its collector goes High. Capacitor A6C11 begins to charge through A6R3, A6R10, and A6CR4. After approximately 10 ms, A6Q7 turns on and the collector goes Low which activates:

1. FM Cal Relay 2 in the A3 Assembly grounding the input.
2. FM Cal Relay 1 in the A7 Assembly which couples the 20 MHz reference signal to the phase detector.

When the multivibrator A6Q4/Q5 returns to its steady state, the HLC output immediately returns to its normal level. The FM Cal Relay 1 and 2 and FM Cal Flag outputs take about 50 ms to return to their normal operating state because the voltage on A6C11 now discharges through A6R11 and A6R12. Once the threshold voltage of transistor A6Q7 is reached, A6Q7 turns off and the FM Cal Relays return to their normal state.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the FM Attenuator Assembly as a result of using the Troubleshooting of Service Sheet 1. Troubleshoot by using the test equipment and procedures outlined below.

Test Equipment

True RMS Voltmeter	HP 3403C
Oscilloscope	HP 180C/1801A/1821A
10:1 Oscilloscope Probe	HP 10004A
AC Voltmeter	HP 400GL

Initial Test Conditions

Modulation Section removed from mainframe but connected with an extender cable, covers removed, and A6 FM Attenuator Assembly installed on an extender board (see Figure 8-2).

Set the Modulation Section to FM MODE and either INTERNAL SOURCE or EXTERNAL AC with an input of 1 to 2 Vrms and the frequency within the FM frequency limits for the malfunctioning switch position.

SERVICE SHEET 6 (Cont'd)

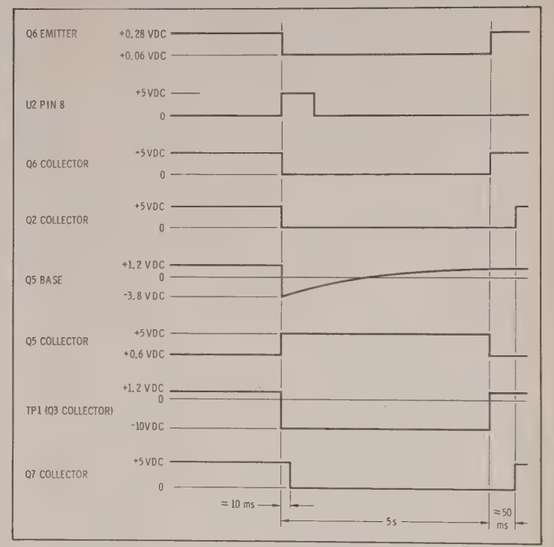


Figure 8-15. FM Center Frequency Calibration Time Sequence

NOTE

After making repairs in any part of the FM Attenuator circuits, adjustment procedures specified in Section V should be performed to ensure proper operation of the instrument.

Some of the circuit functions occur only for a period of five seconds after pressing the FM CF CAL pushbutton. Press this pushbutton before making any measurement controlled by this circuit and make the measurement within five seconds after pressing the pushbutton.

Before attempting to troubleshoot the A6 Assembly, verify that the power supply voltages are within 0.25 volt of the values shown on the schematic.

A3 Remote Attenuation Assembly
SERVICE SHEET 5

SERVICE SHEET 6 (Cont'd)

If the modulation meter does not indicate, the malfunction concerns modulation, go to Test Procedure (1). If the modulation meter indicates, but either continues to indicate when the FM CF CAL pushbutton is pressed or goes to zero and does not return, the malfunction is in the operation of the FM CF CAL pushbutton or associated circuits, go to Test Procedure (2).

Test Procedure (1) Modulation Operation

Test 1-a. Set the Modulation Section for INTERNAL SOURCE FM X1 modulation with either 400 Hz or 1000 Hz modulation. Measure the ac voltage at A6TP2 with an ac voltmeter. If this voltage is correct at approximately 0.7 Vrms, go to Test 1-b. If this voltage is incorrect, trace the modulation signal back to Service Sheet 5.

Test 1-b. Measure the ac voltage at A6TP3. If this voltage is correct at approximately 0.7 Vrms, go to Test 1-c. If this voltage is incorrect, check A6U1B and C and associated circuitry.

Test 1-c. Measure the ac voltage at A6TP4. The voltages with different switch positions should be as follows:

Switch Setting	Voltage
FM X10	approximately 0.7 Vrms
FM X1	approximately 0.07 Vrms
FM X0.1	approximately 0.007 Vrms

If these voltages are correct, trace the signal to Service Sheet 7. If any voltage is incorrect, go to Test 1-d.

Test 1-d. Check continuity between pins 1 and 4 on the following relays with the following MODE switch settings:

Switch Position	Test Relay
FM X10	A6K1
FM X1	A6K2
FM X0.1	A6K3

If pins 1 and 4 on the appropriate relays are closed, check the associated resistors. If the relays are not closed, go to Test 1-e.

Test 1-e. Check for a Low (<+0.8 Vdc) at the following XA6 connector pins with the following MODE switch settings:

Switch Position	Low on XA6 Pin
FM X10	M
FM X1	N
FM X0.1	13

If these voltages are correct, replace the malfunctioning relay. If these voltages are incorrect, trace the incorrect voltage back to Service Sheet 2.

Test Procedure (2) FM CF CAL Pushbutton Operation

Refer to Figure 8-15 for the waveforms associated with this test procedure.

Test 2-a. Set the MODE switch to the malfunctioning FM multiplier position. Measure the voltage at A6TP1 with an oscilloscope within 5 seconds after pressing the FM CF CAL pushbutton. See Figure 8-15. This voltage should rise to approximately +1.2 Vdc. If this voltage is correct go to Test 2-g. If voltage is incorrect, go to Test 2-b.

Test 2-b. Measure the voltage at the collector of A6Q6, while pressing the FM CF CAL pushbutton. This voltage should be +5 Vdc and drop to approximately 0.8 Vdc. If this voltage is correct, probably A6Q3 or associated circuitry is defective. If this voltage is not correct, go to Test 2-c.

Test 2-c. Measure the voltage at the emitter of A6Q6, while pressing the FM CF CAL pushbutton. This voltage should be approximately +0.28 Vdc and drop to approximately +0.06 Vdc. If this voltage is correct, check A6Q3 and A6Q6. If this voltage is incorrect, go to Test 2-d.

Test 2-d. Measure the voltage at A6U2C pin 8, while pressing the FM CF CAL pushbutton. This voltage should go High (>+2.4 Vdc). If this voltage is correct, check A6CR1. If this voltage is incorrect, go to Test 2-e.

Test 2-e. Check inputs to A6U2C while pressing FM CF CAL pushbutton. Pin 10 should be Low (<+0.8 Vdc) while pins 9 and 11 should be High (>+2.4 Vdc). If these voltages are correct, go to Test 2-f. If these voltages are incorrect, trace incorrect voltage back to source, repair or replace faulty component.

Test 2-f. Measure the voltage at pin 12 of A6U2A. This voltage should be High (>+2.4 Vdc). If this voltage is correct, check A6CR2. If this voltage is incorrect, measure the voltages at pins 1, 2, and 8 of U2A. One of these voltages should be Low

SERVICE SHEET 6 (Cont'd)

(depending upon FM multiplier switch setting) and the other two High. If these voltages are correct, replace A6U2A. If these voltages are incorrect, trace the incorrect signal to its source and repair or replace the faulty component.

Test 2-g. Measure the voltage at the collector of A6A7 while pressing the FM CF CAL pushbutton. This voltage should drop from +5 Vdc to approximately 0 volts. If these voltages are correct, go to Test 2-i. If these voltages are incorrect, go to Test 2-h.

Test 2-h. Measure the voltage at the base of A6Q7 while pressing the FM CF CAL pushbutton. This voltage should go to >+0.6 Vdc. If this voltage is incorrect, check A6Q7, A6CR8 and 9, and associated circuitry. If this voltage is incorrect, check A6Q4 and 5, A6CR4 and 5, and associated circuitry.

Test 2-i. Perform VCO Center Frequency Adjustment in Section V. If the center frequency will not adjust, go to Test 2-j. If the center frequency will adjust, go to Test 2-l.

Test 2-j. With an ohmmeter, measure continuity across pins 3 and 4 of A3K11 when the FM CF CAL pushbutton is pressed. Repeat the measurement across pins 3 and 4 of both relays A7A2K3 and 4 in series by measuring between Test locations A7A2TPD and A7A2TPF (the A7A2 board must be removed to measure each relay individually). If there is continuity between the Test locations, both relays are operating.

Test 2-k. Trace the circuit to the malfunctioning relay and its power supply. If the circuit is proper and the voltage is +5 ±0.5 Vdc, replace the malfunctioning relay. If the circuit is not proper or if the voltage is not proper, fix or replace the faulty component.

Test 2-l. Measure the voltage at XA6 pin 11 as the FM CF CAL pushbutton is pressed. This voltage should go Low (<+0.8 Vdc). If this voltage does go Low, trace the voltage through A8 and A2 (Service Sheet 2) to the mainframe. If this voltage does not go Low, check A6Q1 and 2 and associated circuitry.

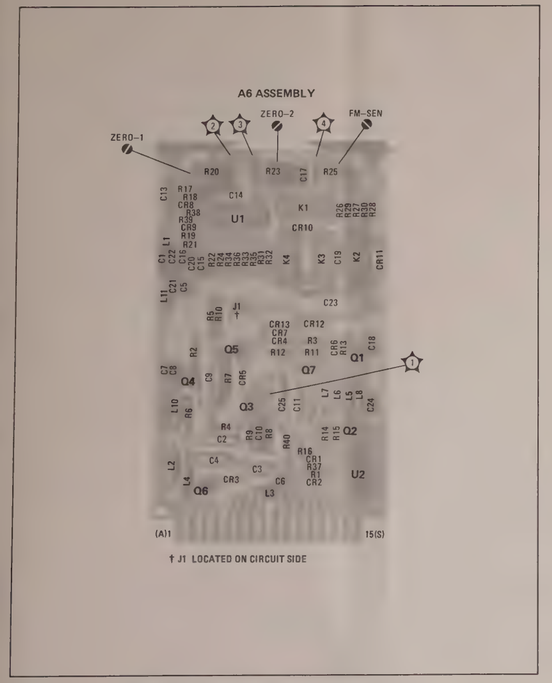


Figure 8-16. A6 FM Attenuator Assembly Component Locations

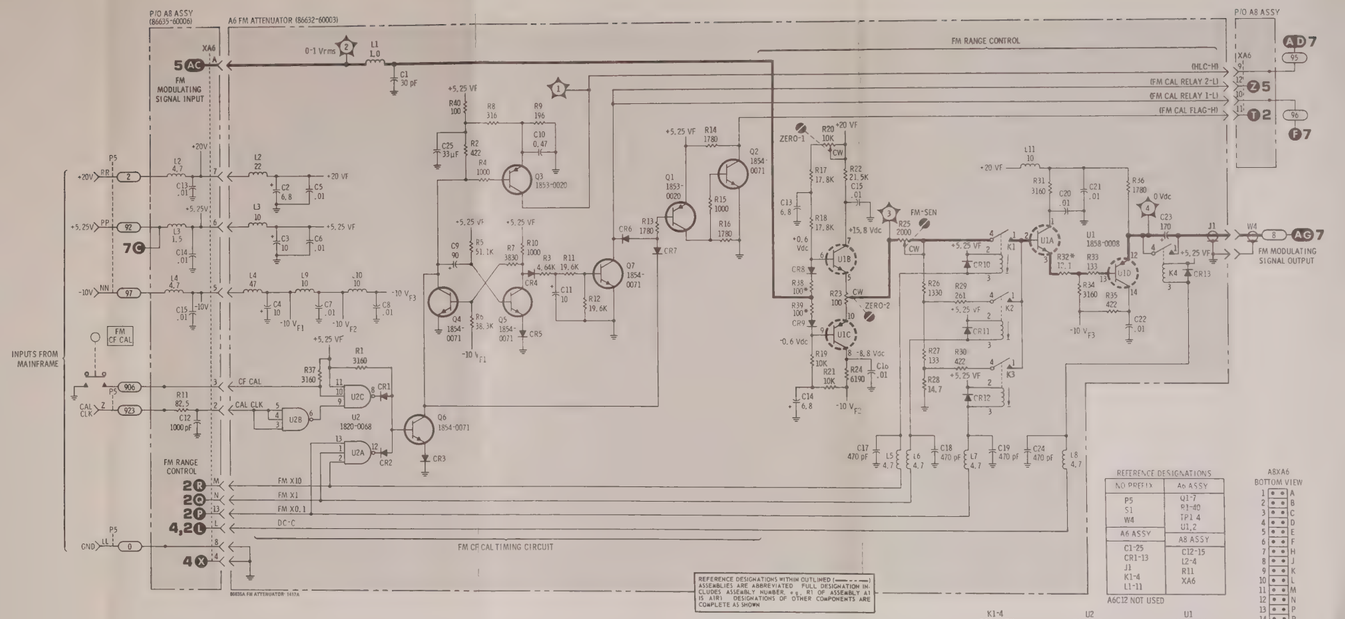

P/O A8 ASSY (86635-60006)
A6 FM ATTENUATOR (86632-60003)
FM MODULATING SIGNAL INPUT
FM RANGE CONTROL
FM CF CAL TIMING CIRCUIT
INPUTS FROM MAINFRAME
FM MODULATING SIGNAL OUTPUT
REFERENCE DESIGNATIONS
A6C12 NOT USED
NOTES
1. REFER TO FIGURE 8-1 FOR EXPLANATION OF SYMBOLS.
2. U2 PIN 14 IS 5 Vdc, PIN 7 IS GROUND.
K1-4 TOP VIEW
U2 TOP VIEW
U1 TOP VIEW
A6X6 BOTTOM VIEW

Figure 8-17. A6 FM Attenuator Assembly Schematic Diagram

SERVICE SHEET 7

NOTE

Begin overall troubleshooting by first following the procedures given in Section VIII of the Model 8660 series mainframe Operating and Service Manual. After the trouble has been isolated to the 86635A Modulation Section, perform the troubleshooting given in this manual on Service Sheet 1. After both of these steps have been performed and the malfunction has been isolated to the A7A1 20 MHz Mixer Assembly, the A7A2 20 MHz Switch Assembly, or the A7A3 20 MHz VCO Assembly the following troubleshooting procedure is recommended.

PRINCIPLES OF OPERATION

A7A1 20 MHz Mixer Assembly

The 20 MHz VCO output, at a level of about 480 mVp-p, is coupled to amplifiers A7A1Q1 and 2 and their output is coupled to the phase detector circuit.

During the FM center-frequency calibration (FM CF CAL) cycle, the 20 MHz reference, at a level of about 480 mVp-p, from the mainframe is coupled to A7A1Q4 and 3. Both of these signals are combined in the phase detector.

The phase detector consists of A7A1T1, A7A1CR1 and 2, and a low-pass filter. The two 20 MHz signals are compared in the phase-detector circuit and the dc output is coupled to the A7A3C33 error-voltage storage capacitor in A7A3.

A7A2 20 MHz Switch Assembly

During the OFF and AM modes the 20 MHz reference signal from the mainframe is coupled through relays A7A2K1 and A7A2K3 to the RF Section. In FM mode, the frequency-modulated 20 MHz VCO signal is coupled through A7A2K1 to the RF Section and the 20 MHz reference is coupled to A7A2K4 via A7A2K3. During the FM center frequency calibration cycle, relay A7A2K4 couples the 20 MHz reference signal from the Mainframe to the phase detector on A7A1. A7A2K2 grounds the AM output line during FM mode.

A7A3 20 MHz VCO Assembly

During FM CF CAL operation, a dc error voltage from A7A1 Mixer is stored on A7A3C33. This voltage is amplified by A7A3U1 and is coupled to the varactor diodes A7A3CR9, 10, and 11 in the VCO. This voltage is used to phase lock the VCO center frequency to the 20 MHz reference signal.

The frequency-modulating signal from the A6 FM Attenuator Assembly is coupled to the varactor diodes through A7A3L4 and A7A3C15. The change in voltage on the varactors changes their capacitance and therefore changes the VCO frequency at a rate determined by the modulating frequency. The amplitude of the modulating signal determines the modulation level (peak deviation) of the RF output from the RF Section.

SERVICE SHEET 7 (Cont'd)

The VCO circuit consists of oscillator A7A3Q3 and a tuned circuit consisting of A7A3L3, A7A3CR9 to 11, and A7A3C17. While capacitors A7A3C18 and 19 do add some capacitance to the tuned circuit, they are mainly used to couple the VCO output to A7A3Q1. Capacitor A7A3C14 is a trimmer capacitor which helps to linearize the frequency-versus-voltage curve. When a dc voltage is coupled to the varactor diodes the capacitance, and therefore the frequency of the VCO, changes.

The VCO tuned circuit is coupled to A7A3Q1. Positive feedback from the A7A3Q1 source terminal is coupled to the emitter of A7A3Q3. The output from the drain terminal of A7A3Q1 is coupled to buffer amplifier A7A3Q2. The output of the buffer is coupled to the A7A1 20 MHz Mixer Assembly and to the A7A3Q6 and Q5 output amplifiers. The 20 MHz output from A7A3Q5 is coupled to the RF Section through the A7A2 20 MHz Switch Assembly.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the A7A1, A7A2, and A7A3 Assemblies as a result of using the Troubleshooting of Service Sheet 1. Troubleshoot by using the test equipment procedures specified below and refer to the A7 schematic and component location diagrams.

Test Equipment

True RMS Voltmeter	HP 3403C
Oscilloscope	HP 180C/1801A/1821A
10:1 Oscilloscope Probe	HP 10004A
Extender Cable	HP 11672-60002

Initial Test Conditions

Modulation Section removed from mainframe but connected by extender cable, covers removed, and rear-panel assembly opened to allow access to suspected assembly.

NOTE

After making repairs in any part of the rear-panel assembly, adjustment procedures specified in Section V should be performed to ensure proper operation of the instrument.

Before attempting to troubleshoot the A7 Assemblies, verify that the power supply voltages are within 0.25 volt of the values shown on the schematic. Set the Modulation Section for FM X10 MODE, INTERNAL SOURCE 400, and MODULATION LEVEL to an indication of 50 on the meter.

Test Procedure (1) A7A1 Assembly

Test 1-a. With an oscilloscope, measure the voltage at the primary of A7A1T1 when the FM CF CAL pushbutton is pressed. This voltage

SERVICE SHEET 7 (Cont'd)

should be approximately 2.6 Vp-p. If this voltage is correct, proceed to Test 1-d. If this voltage is incorrect, proceed to Test 1-b.

Test 1-b. With an oscilloscope, measure the voltage at Test location "VCO" on A7A1. This voltage should be approximately 480 mVp-p. If this voltage is incorrect, proceed to Test 1-c. If this voltage is correct, A7A1Q1, 2, or an associated component is defective.

Test 1-c. Verify that continuity exists between test locations A7A3TPC and "VCO" on A7A1. If connection is good, proceed to Test Procedure (3). If continuity does not exist, repair connection.

Test 1-d. Measure the 20 MHz reference voltage at the centertap of A7A1T1 during the FM CF CAL calibration cycle. Connect the oscilloscope probe with the sweep speed set to 0.5 seconds/division. Press the FM CF CAL pushbutton and take the measurement within 5 seconds. If this voltage is approximately 2.6 Vp-p amplitude, proceed to Test 1-g. If this voltage is incorrect, proceed to Test 1-e.

Test 1-e. Measure the reference input (REF) voltage at A7A1C4 within 5 seconds after pressing the FM CF CAL pushbutton. If this voltage is correct (approximately 480 mVp-p) the malfunction is caused by A7A1Q3, 4, or an associated component. If this voltage is not correct, proceed to Test 1-f.

Test 1-f. Verify Reference Signal continuity from A7A2TPF to A7A1C4. If continuity exists, proceed to Test Procedure (2). If continuity does not exist, or is grounded, repair the interconnection.

Test 1-g. Connect an oscilloscope to A7A1TP1 and verify that 0V (phase lock) occurs during the five-second FM CF CAL cycle. If an ac voltage is found, proceed to Test Procedure (3). If zero voltage (phase lock) is observed on the oscilloscope, perform the VCO center-frequency adjustment given in Section V. If phase lock cannot be obtained by this adjustment, go to Test 1-h.

Test 1-h. Disconnect the Modulation Section from the extender cable. Measure continuity between A7A1TP1 to A7A3TPA (tie point at A3K1) and A7A3Q8. If continuity exists, go to Test Procedure (3). Otherwise, repair or replace the defective item. Reconnect adapter cable.

Test Procedure (2) A7A2 Assembly

Test 2-a. If the malfunction occurs in the FM Mode, go to Test 2-c. If the malfunction occurs in the ϕM or OFF Mode, measure the reference signal to A7A2TPD. (Remove coaxial cable and measure at the center conductor of the cable.) If voltage is approximately 480 mVp-p at this point, proceed to Test 2-b. If not, trace the reference signal from the mainframe.

SERVICE SHEET 7 (Cont'd)

Test 2-b. With the MODE switch set to ϕM or OFF, measure the voltage at A7A2TPE. If this voltage is approximately 480 mVp-p, trace this voltage to the RF Section. If this voltage is incorrect, trace this voltage through A7A2K3, 2, and 1.

Test 2-c. With the MODE switch set to FM, measure the voltage at A7A2TPE. If this voltage is correct, approximately 340 mVp-p, proceed to Test 2-d. If this voltage is incorrect, proceed to Test Procedure (3).

Test 2-d. In the FM Mode, press the FM CF CAL pushbutton and note within 5 seconds the reference signal at A7A1C4. This voltage should be approximately 480 mVp-p. If this voltage is incorrect, check the reference signal through A7A2K3 and 4.

Test Procedure (3) A7A3 Assembly

Test 3-a. Measure the voltage at A7A3TP1. This voltage should be +6 ±1 Vdc. If the voltage is correct, proceed to Test 3-d. If the voltage is incorrect, proceed to Test 3-b.

Test 3-b. Measure the voltage at A7A3U1 pin 3. This voltage should be between +3 and +5 Vdc. If this voltage is incorrect, proceed to Test 3-c. If this voltage is correct A7A3U1 or an associated component is defective.

Test 3-c. Ground the teflon-insulated tiepoint at the input to A7A3Q7. Measure the voltage at A7A3U1 pin 3. This voltage should be between +3 and +5 Vdc. If the voltage is correct, A7A3K1, Q8 or an associated component is defective. If this voltage is incorrect, transistor A7A3Q7 is defective. Remove the ground from the tiepoint.

Test 3-d. Set the Modulation Section for FM X10 MODE, INTERNAL SOURCE, and adjust MODULATION LEVEL control for an indication of 50 on the meter. Measure the Modulating Signal Input at the Modulating Signal Input tiepoint marked "FM". This voltage should be approximately 1.0 Vp-p. If this voltage is correct, proceed to Test 3-f. If this voltage is incorrect, proceed to Test 3-e.

Test 3-e. Verify that continuity exists between A6 and A7A3 Modulating Signal Input testpoint marked "FM". If continuity exists, proceed to the Troubleshooting on Service Sheet 5. If continuity does not exist, repair it.

Test 3-f. With an oscilloscope, measure the output at A7A3TPB. This voltage should be approximately 330 mVp-p. If the voltage is correct, go to Test 3-g. If the voltage is incorrect, go to Test 3-h.

Test 3-g. Verify that continuity exists between tiepoint VCO on the A7A2 Assembly and tiepoint A7A3TPB on A7A3 Assembly. If continuity does exist, go to Test Procedure (2). If continuity does not exist, repair it.

Test 3-h. Measure the A7A3 VCO signal with an oscilloscope at testpoint C on A7A3. The voltage should be approximately 480 mVp-p. If this voltage is not correct, go to Test 3-i. If this voltage is correct, transistors A7A3Q5, 6, or an associated component is defective.

Test 3-i. With an oscilloscope, measure the peak-to-peak ac voltage at the drain of A7A3Q1. This voltage should be approximately 480 mVp-p. If this voltage is not correct, proceed to Test 2-j. If this voltage is correct, transistor A7A3Q2 or an associated component is defective.

Test 3-j. With a voltmeter, measure the dc voltage at the drain of A7A3Q1. This voltage should be approximately —1.8 Vdc. If the voltage is correct, a component associated with the VCO is defective. If the voltage is incorrect, probably A7A3K2, A7A3Q1, or an associated component is defective.

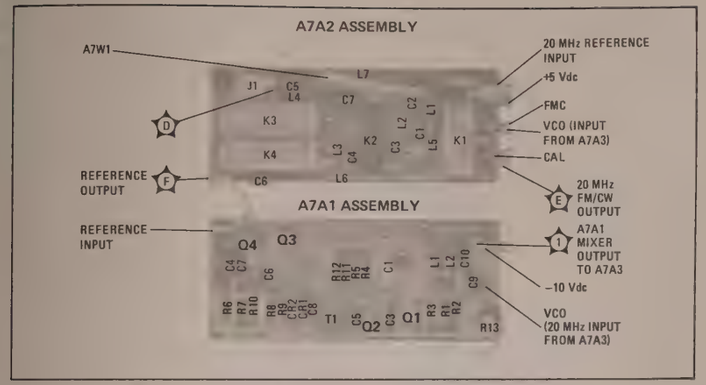


Figure 8-18. A7A1 20 MHz Mixer and A7A2 Switch Assembly Component Locations

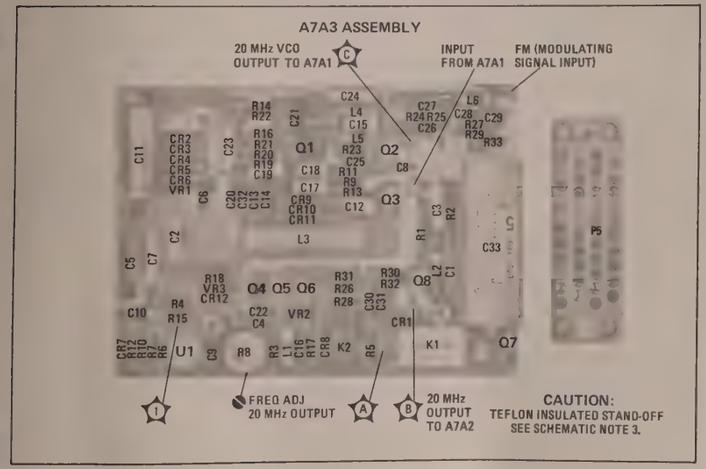
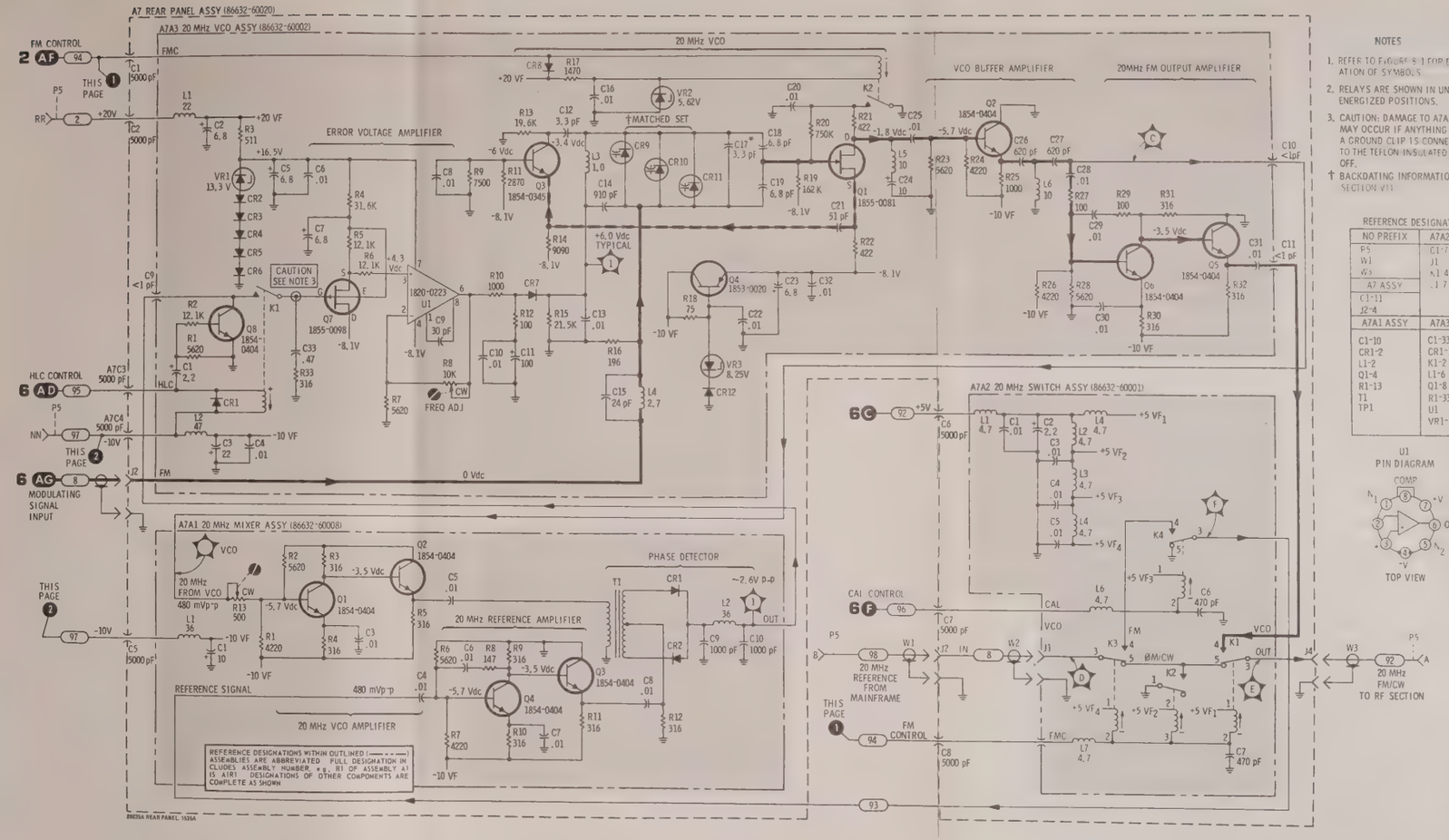

A7A3 ASSEMBLY
20 MHz VCO OUTPUT TO A7A1
INPUT FROM A7A1
FM (MODULATING SIGNAL INPUT)
FREQ ADJ 20 MHz OUTPUT
20 MHz OUTPUT TO A7A2
CAUTION: TEFLON INSULATED STAND-OFF SEE SCHEMATIC NOTE 3.

Figure 8-19. A7A3 20 MHz VCO Assembly Component Locations


A7 REAR PANEL ASSY (86632-60020)
A7A3 20 MHz VCO ASSY (86632-60002)
20 MHz VCO
ERROR VOLTAGE AMPLIFIER
VCO BUFFER AMPLIFIER
20MHz FM OUTPUT AMPLIFIER
FM CONTROL
HLC CONTROL
MODULATING SIGNAL INPUT
CAUTION SEE NOTE 3
FREQ ADJ
A7A2 20 MHz SWITCH ASSY (86632-60001)
CAL CONTROL
20 MHz REFERENCE FROM MAINFRAME
20 MHz FM/CW TO RF SECTION
A7A1 20 MHz MIXER ASSY (86632-60008)
PHASE DETECTOR
20 MHz REFERENCE AMPLIFIER
20 MHz VCO AMPLIFIER
REFERENCE SIGNAL
20 MHz FROM VCO
REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED AND INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

NOTES

1. REFER TO FIGURE 8-1 FOR EXPLANATION OF SYMBOLS.
2. RELAYS ARE SHOWN IN UNENERGIZED POSITIONS.
3. CAUTION: DAMAGE TO A7A3Q7 MAY OCCUR IF ANYTHING EXCEPT A GROUND CLIP IS CONNECTED TO THE TEFLON INSULATED STAND-OFF.

† BACKDATING INFORMATION IN SECTION VIII.

REFERENCE DESIGNATIONS

NO PREFIX	A7A2 ASSY
P5	C1-7
W1	J1
W3	K1-4
A7 ASSY	L7
C1-11	
J2-4	
A7A1 ASSY	A7A3 ASSY
C1-10	C1-33
CR1-2	CR1-15
L1-2	K1-2
Q1-4	L1-6
R1-13	Q1-8
T1	R1-33
TP1	U1
	VR1-3

U1 PIN DIAGRAM

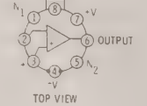


Figure 8-20. Rear Panel (A7A1, 2 and 3) Assembly Schematic Diagram

SERVICE SHEET 8

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660 series mainframe Operating and Service Manual to begin troubleshooting. If this indicates trouble in the Model 86635A Modulation Section, refer to Service Sheet 1 of this manual. Service Sheet 1 provides overall troubleshooting and is keyed to all other Service Sheets.

A9 DEVIATION DETECTOR ASSEMBLY

PRINCIPLES OF OPERATION

This assembly monitors the meter drive circuit in the A3 Assembly. If the positive input from A3 exceeds a set level, the circuit generates a signal to turn on the REDUCE DEVIATION indicator. A flag output taken from the same signal, is sent to the mainframe and to the A2 Switch Logic Assembly.

A reference input to comparator A9U3 pin 3 is set to +1.4V with resistor A9R12. If the input to A9U3 pin 2 exceeds the reference level, A9U3 pin 6 goes Low. This Low is applied through AND gate A9U2A to lamp driver A9Q1. The Low level turns on A9Q1. When A9Q1 conducts, REDUCE DEVIATION lamp DS3 is turned on. A9U2B, also connected to the output of A9U2A, is used to send a Low flag to the mainframe and to disable the FM MODE output in A2.

Retriggerable one-shot A9U1 is triggered each time a Low appears at A9U3 pin 6. A9U1 generates a 0.5-second Low output with each trigger. Since the output of A9U1 is connected to A9U2A pin 1, A9U1 assures that the minimum time the output of U2A remains Low is 0.5 of a second.

Phase Modulation Output Amplifier

The output is a ϕM drive signal to the RF Section via the mainframe. When ϕM is selected (either in remote or local mode of operation), the ϕM input signal is amplified by A9U4. To check A9U4 apply a 100 kHz 1.0 Vrms signal to front panel J1 and measure A9TP1 for a 1.5 Vrms signal.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the Deviation Detector Assembly as a result of using the Troubleshooting of Service Sheet 1. Troubleshoot by using the test euqipment and procedures outlined below.

Test Equipment

True RMS Voltmeter ..... HP 3403C
Extender Cable ..... HP 11672-60002

A7 Rear Panel Assembly
SERVICE SHEET 7

SERVICE SHEET 8 (Cont'd)

Initial Test Conditions

Modulation Section removed from mainframe but connected by an extender cable, covers removed, and the A9 Deviation Detector Assembly installed on an extender board.

NOTE

After making repairs in any part of the deviation detector assembly circuits, the adjustment procedures specified in Section V for the deviation detector should be performed to ensure proper operation of the instrument.

Test Procedure

Before troubleshooting the A9 Assembly, verify that the power supply voltages (+20V, +5.25V, −10V) are present (±0.25 Vdc). Set the mainframe center frequency to 1000 MHz. Set the Modulation Section SOURCE control to 1000 Hz, the MODE control to FM X1 and adjust MODULATION LEVEL control to obtain 110% full scale indication on modulation meter.

Test 1-a. Verify input of +1.5V at A9U3 pin 2, then proceed to Test 1-b (further adjustment of MODULATION LEVEL control may be required to obtain +1.5V). If input is not present, a continuity defect exists between A3 and A9. If so, disconnect extender cable, make continuity checks and repair.

Test 1-b. Verify Low (<0.8V) at A9U2A pin 3. If Low and DS3 does not light, Q1, R13, R14, or DS3 are defective. If A9U2A is High and DS3 lights, A9U2 is defective. If A9U2A pin 3 is High and DS3 does not light proceed to test 1-c. If A9U2A pin 3 is Low and DS3 lights but for periods less than 1/2 a second, proceed to test 1-e.

Test 1-c. Verify +1.4V at A9U3 pin 3, adjust A9R12 as necessary and proceed to test 1-d. If unable to obtain +1.4V, R4, R5, R12 or U3 is defective. Replace defective part.

Test 1-d. Verify Low at A9U3 pin 6. If not Low, replace A9U3. If Low replace A9U2.

Test 1-e. Verify Low at A9U1 pin 6. If not Low replace A9U1.

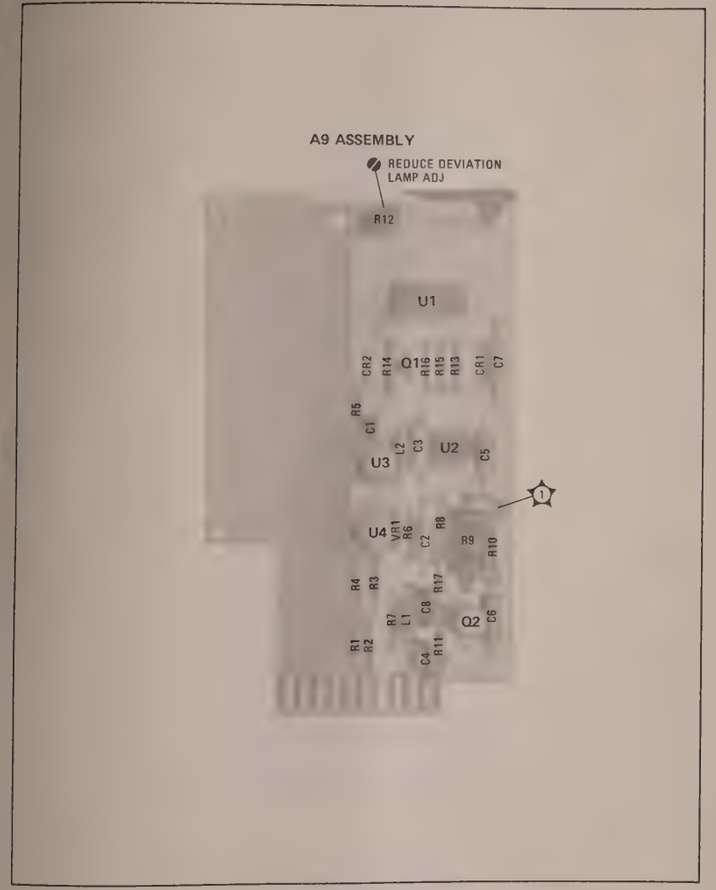


Figure 8-21. A9 Deviation Detector Assembly Component Locations

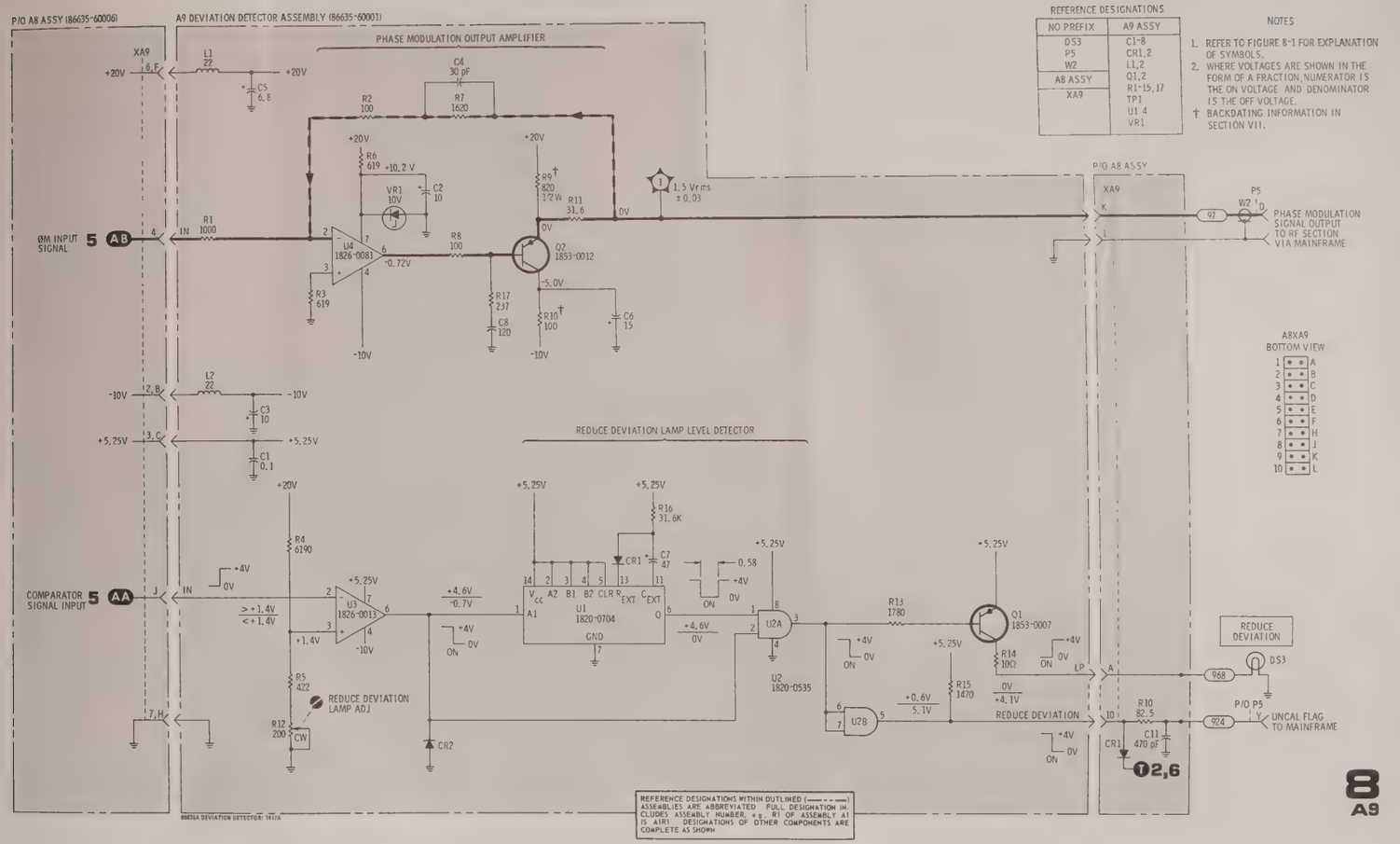

P/O A8 ASSY (86635-60006)
A9 DEVIATION DETECTOR ASSEMBLY (86635-60001)
PHASE MODULATION OUTPUT AMPLIFIER
REDUCE DEVIATION LAMP LEVEL DETECTOR
ØM INPUT SIGNAL 5 AB
COMPARATOR SIGNAL 5 AA
REDUCE DEVIATION LAMP ADJ
1.5 Vrms ± 0.03
PHASE MODULATION SIGNAL OUTPUT TO RF SECTION VIA MAINFRAME
REDUCE DEVIATION
UNCAL FLAG TO MAINFRAME
REFERENCE DESIGNATIONS
NO PREFIX
A9 ASSY
DS3
P5
W2
A8 ASSY
XA9
C1-8
CR1,2
L1,2
Q1,2
R1-15,17
TP1
U1 4
VR1
NOTES
1. REFER TO FIGURE 8-1 FOR EXPLANATION OF SYMBOLS.
2. WHERE VOLTAGES ARE SHOWN IN THE FORM OF A FRACTION, NUMERATOR IS THE ON VOLTAGE AND DENOMINATOR IS THE OFF VOLTAGE.
† BACKDATING INFORMATION IN SECTION VII.
A8XA9 BOTTOM VIEW
REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN
8
A9

Figure 8-22. A9 Deviation Detector Assembly Schematic Diagram

MAINFRAME INTERCONNECT JACK

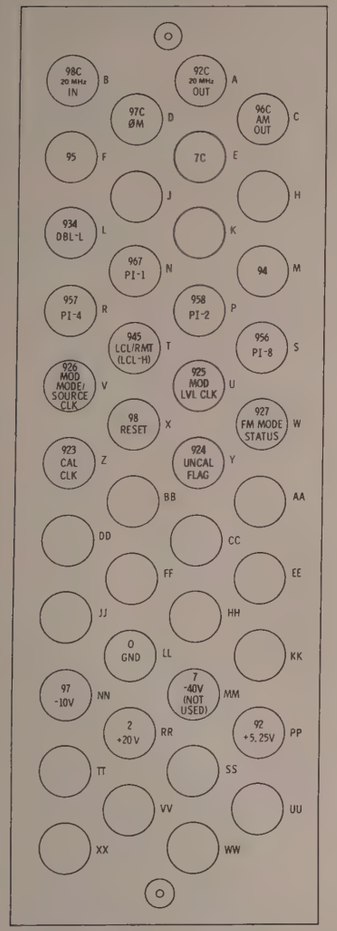


Figure 8-23. Mainframe Interconnect Jack

GENERAL REMOVAL AND DISASSEMBLY PROCEDURES

CAUTION

Before removing Modulation Section plug-in from the mainframe, remove the power by disconnecting the instrument's power cable from the power outlet.

Plug-in Module Removal

a. Press latch in lower right corner of the module towards the center of the module and pull latch forward.

b. Pull extended latch towards you to remove plug-in from mainframe.

Model 86635A Modulation Section Disassembly

a. With a small Pozidriv screwdriver, remove eight screws in each side cover and remove both covers.

b. Remove two screws in top teflon guide and remove the top guide. (If access is required to A8, A7A1, or A7A2 circuit boards, also remove two screws in bottom guide and remove guide).

c. If board is to be removed is one of A2 through A6, simultaneously pull up on both plastic arms associated with that card.

A1 Front Panel Disassembly

a. Remove two screws holding front panel at top and one screw holding bottom (rotate latch fully to reach bottom screw).

b. Remove knurled ring nut holding INPUT/OUTPUT jack using a knurled nut wrench. Pull front panel forward. The ribbon connector may be disconnected at A2 board.

A7A1 and A7A2 Access

a. Remove top screws on each side of rear housing. Rotate rear housing backwards.

b. Remove screws holding cover plate and remove cover plate.

Reassembly Procedure

Reassemble in the reverse order of disassembly. Replace the teflon guide before replacing the two covers. The extra notch in the cover must face the rear. These notches provide clearance for screws holding the guides in the mainframe when reinserting the module. If the Modulation Section will not go all the way into the mainframe, check that these notches in the covers face to the rear.

A9 Deviation Detector Assembly
SERVICE SHEET 8

A8 MOTHER BOARD ASSEMBLY
(Assemblies A2 through A6 and A9 removed)

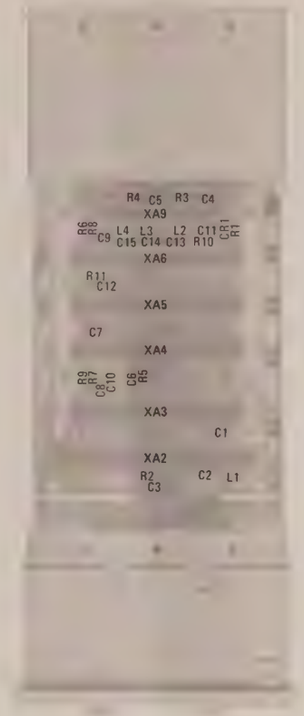


Figure 8-24. A8 Mother Board Assembly Component Locations

Table 8-4. Assembly, Chassis Mounted Parts, and Adjustable Component Locations

Reference Designator	Service Sheet	Figures	Remarks
A1 Assembly A2 Assembly A3 Assembly A3R36 Meter Adj A3R6 Zero A3R37 Gain	1, 2 1, 2 1, 5 5	8-25 8-6, 25 8-13, 25 8-13, 25	8-25 rear view at front panel
A4 Assembly A4R35 Level Adj A4R45 Gain Adj	1, 4 4 4	8-10, 25 8-10, 25 8-10, 25	
A5 Assembly A5R15 400 Hz Adj A5R16 1000 Hz Adj	1, 3 3 3	8-8, 25 8-8, 25 8-8, 25	
A6 Assembly A6R25 FM Sensitivity Adj	1, 6 6	8-16, 25 8-16, 25	
A7 Assembly A7A1 Assembly A7A1R13 A7A2 Assembly A7A3 Assembly A7A3R8 Freq Adj	1, 7 1, 7 1, 7 1, 7 1, 7 7	8-25 8-18, 25 8-18, 25 8-19 8-19	 Access by removing rear panel cover. Access through rear panel cover.
A8 Assembly A9 Assembly A9R12 Reduce Deviation Lamp Adj	2-8 1, 8 8	8-24 8-21, 25 8-21, 25	 8-25, top view
DS1 DS2 DS3	1, 2 1, 2 1, 8	8-25 8-25 8-25	} rear view of front panel
J1 M1 P5 R1 S1	1, 3 1, 5 1,2, 5-8 1, 5 1, 6	8-25 8-25 8-19, 23, 25 8-25 8-25	bottom view rear view of front panel rear view of front panel rear view of front panel
W1 W2 W3 W4	1, 7 1, 8 1, 7 1, 6, 7	8-25 8-25 8-25 8-25	

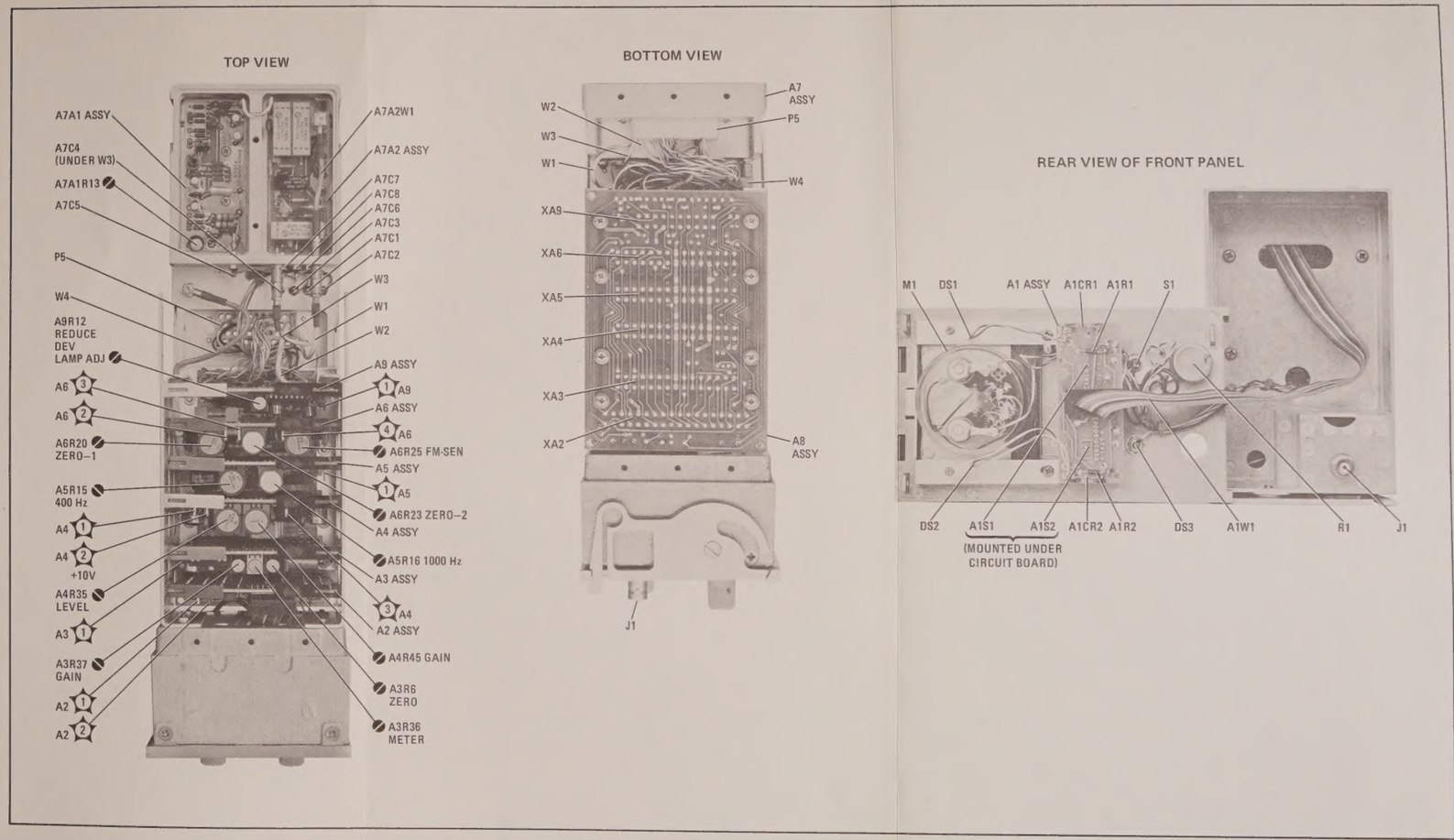


Figure 8-25. Assembly, Chassis Mounted Parts, Adjustable Components and Test Point Locations

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Bechovice u Prahy
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Vyskumny Ustav Lekarskej Bioniky
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King Street Lane
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Telex:847178/9

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USSR
Hewlett-Packard
Representative Office USSR
Pokrovsky Boulevard 4/17-KW 12
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